JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

DEVOTED TO THE

MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

JANUARY, 1835.

Report to the Board of Directors of the London and Birmingham Railway, on the Formation of a Railway by Undulatory Planes. By ROBERT STEPHENSON, *Esq., Engineer. Dated 5th May,* 1834.*

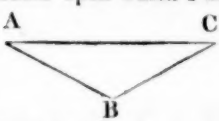
Since the receipt of the memorial to the directors, respecting the formation of railways by undulatory planes, I need scarcely say that I have been so closely occupied, that I found it impossible to reconsider, carefully, the opinions I had formed on the subject several months ago, founded upon some experiments in "The Gallery of Practical Science," with a model prepared by Mr. Badnall. These experiments were considered by several persons conclusive in favour of an undulatory surface for a line of railway.

I drew a different conclusion from them, and made some remarks and calculations at the time, which I considered fully confirmed it. Since that time, I have read the greater part of the controversy, which has been carried on in the "Mechanics Magazine," and paid especial attention to the experiments made upon the Rainhill plane,

* We have received from Mr. Stephenson, in addition to the manuscript now printed, one containing remarks and calculations on the best form for railway bars, &c., the publication of which we propose to commence in the next number.

with several of the locomotive engines belonging to the Liverpool and Manchester Railway Company, without perceiving any reasons for changing the view I originally took.

The following observations are extracted from those above alluded to, as far as appears necessary for explaining the outline of the arguments upon which I had based my views:



A C, a horizontal plane.

A B and B C, two inclined planes completing one undulation.

A carriage, in moving over the inclined plane, may be conceived to be acted upon by three forces, viz:

First.—Gravity, varying directly as the *sine* of the angle of inclination.

Secondly.—Mechanical force, such as a steam engine, or a spring.

Thirdly.—The uniform retarding force, arising from the friction of the moving parts.

Let n = sine of angle of inclination.
g = force of gravity.
m = mechanical force applied.
f = retarding force arising from friction.

Then the force resulting from the combined action of these three, will be represented by $n\,g + m - f - (m - f;)$ it is evident that the motion of the body is influenced solely by the remaining force $n\,g$, and is precisely in the same condition as if friction were annihilated.

In this case, it is obvious that the body descending the plane A B, would acquire sufficient momentum to carry it up to the similar plane B C; and were there a series of similar undulations, the body would move forward without interruption, and the velocities in each succeeding undulation would be the same, and the expenditure of mechanical power would be the space passed over multiplied into the retarding force $= s\,m$, or $s\,f$, s being the space passed over.

Instead of moving on an undulating surface, let the body be now placed on the horizontal plane A C; its motion in this condition can be influenced by two forces only, viz: the mechanical force m, and the retarding force f. If we suppose, therefore, $m = f$, it is obvious that no motion whatever can take place.

At this point of the comparison, a striking difference, and apparently not an unimportant one, exists between the undulatory and horizontal surfaces. In the former, gravity communicates a certain velocity, which is maintained throughout each succeeding undulation; whereas, in the latter, the forces m and f merely destroy each other; consequently the body remains stationary.

This explains the experiment which was frequently repeated, and in many cases went far to convince several persons of the advantage of having an undulatory surface. Very little reflection, however, is requisite to perceive that this advantage is merely apparent, and not real: for let us suppose that the body at A on the horizontal plane has the mean velocity given to it, which gravity imparts to the body

moving down the first inclined plane of the undulatory surface; it will then move uniformly with this velocity from A to C, and arrive at the latter point at the same time that it would have done on the undulatory line; and however the length may be increased, the body will pass over the distances corresponding to each undulation in the same space of time, whether the surface be undulatory or horizontal.

Let p = power expended in communicating any given velocity to the body on the horizontal surface at A; then the whole power expended in moving the body from A to C, will be $p + s\,m$, or $p + s\,f$.

But when the body arrives at C, it retains its original velocity, and is capable of employing its power, or of moving itself beyond C; whereas, on the undulating surface, the body becomes quite stationary at C. In short, it is a well known law in mechanics, that the velocity which the body possesses is exactly equal to the power expended in communicating it; we therefore have the absolute expenditure of power in moving the body from A to C $= s\,m$ or $s\,f$, which is precisely the same result as on the undulating surface.

Hitherto we have the forces m and f equal, by which the friction, or retarding force, was merely neutralized; but in practice m must exceed f, otherwise no motion could ensue on the level plane. When, therefore, m is greater than f, the body will be accelerated by the differences of those forces, viz: $m - f = d$; in this case the motion of the body on the undulatory surface is influenced by a force represented by $n\,g + d$.

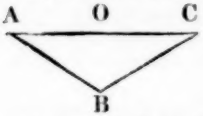
If v and v'' represent the velocities generated by the forces $n\,g$ and d, in the same time, then $v + v''$ will represent the velocity which the joint forces will generate in an equal space of time. But the velocity given by the force $n\,g$ in descending, is lost in ascending; hence, the body will arrive at the summit of each undulation, with the velocity due to the action of the force d, which is $\sqrt{2\,d\,s}$.

Now, the velocity acquired by the action of the force d on the level plane, the body having moved over an equal space, is also $\sqrt{2\,d\,s}$; and this equality in velocity must hold, whatever be the nature of the surface over which the bodies move, undulatory or level.

If the body were actually propelled by the force d more efficiently on the one surface than on the other, it must arrive at the point C with different velocities. The readiest mode of showing that this is not the case, is to allow it to expend the momentum by moving along a horizontal plane, or one of a given inclination; in both cases, the momentum is precisely equal. This experiment I repeated several times, and felt perfectly convinced that the results were exactly determined.

It has been urged by some that the undulatory surface has an advantage from the friction being reduced, in consequence of the body being on an inclined surface. A moment's consideration will show that this never can apply in practice, from the smallness of the inclination which is admissible; the reduction in the friction from this cause would be inappreciable.

But even allowing it to operate, the undulating surface is increased in length by a quantity that exactly compensates for the reduction in the friction of the carriage.



Because the diminution of friction is proportioned to the diminution of weight, which is as A B, A O, but the spaces passed over are as A C : A B + B C, or as A O : A B, exactly the reverse of the former proportion; showing, that though the friction may be reduced on the inclined plane, the distance is increased precisely in a ratio to compensate it.

The above considerations lead me to conclude that, theoretically, there is neither advantage nor disadvantage in the use of an undulating surface for a line of railway; the question, therefore, resolves itself into one of practical application. This I have frequently and carefully considered, and, generally, with a strong bias in favour of Mr. Badnall's view, because I saw clearly that its introduction would at least reduce the expense of constructing public lines of railway; but I have invariably been compelled to conclude that its adoption would be attended with greater expense in the carriage, greater uncertainty in the operation; in many cases greater inconvenience, and in all greater risk of accidents, than in an horizontal line of railway, or on one approaching to it as nearly as circumstances would permit.

Greater ultimate expense, I conceive, would arise in part from the additional wear and tear, both upon carriages and engines, from the varying velocities which must be continually taking place throughout the whole length of the line of road.

This objection is considered by many of no weight; I need only refer, however, to practical men, who have been in the habit of observing the destruction of machinery where varying velocities are admitted; indeed, I cannot refer to a better instance than Rainhill and Sutton inclined planes, where the objectionable nature of inclined planes is evident to all conversant with machinery, and from whence (it is probably not too much to say) a very large portion of the wear and tear of the locomotive engines on the Liverpool and Manchester Railway has sprung.

The engines on an undulating line must obviously, at the bottom of each undulation, attain a velocity considerably greater than what is required upon an horizontal line, where it may be nearly uniform.

Now, in locomotive engines, this single circumstance gives rise to three separate objections, neither of which is undeserving of attention, and which are distinct from that of wear and tear arising simply out of velocity.

First.—In the construction of these machines, it is a consideration of the very first importance, to proportion and adapt the relative speeds of the different parts to the velocity at which the engines are intended to travel; and though I am perfectly aware that these engines are worked at different rates of speed, I have seen sufficient to convince me that uniformity in the velocities is extremely desirable, and that they never perform so economically as when the intended

velocity is adhered to within very narrow limits, which is quite impracticable on an undulating road.

Secondly.—When the velocity of these engines exceeds that for which they are calculated, the steam acts less forcibly on the pistons, and thus produces an absolute loss of power, or, in other words, an increased consumption of fuel.

Thirdly.—From the present construction of locomotive engines, every different speed of traveling is accompanied with a corresponding increase or diminution of the temperature of the fire, which occasions a continual working amongst the different parts of the boiler, from unequal expansion and contraction, which never fails in a short time to render the boiler more or less leaky.

Every experienced steam engine builder has had instances brought under his observation, of the destruction of boilers by being exposed to great variations of temperature. In all railways, except such as are perfectly horizontal, this objection applies with more or less force. I therefore only mention it in this place to shew the tendency of the undulating railway would be to aggravate the evil arising from great inequalities in the temperature.

These are my principal reasons for concluding that the expense of carriage would be greater on an undulated line, and the same remarks appear to me to lead to the conclusion that there would be greater uncertainty in the operation.

Inconvenience would, in my opinion, result from not having the power to halt at any given point on the line of railway. This may be done without inconvenience on a line of road not possessing inclinations beyond the power of the engines; but where the inclinations of the planes exceed that power, it is clear that some expedient must be contrived to overcome the delay that must ensue. I have only heard of one, which I cannot suppose to have been advanced seriously. I allude to the proposal that an engine, when stopped by any chance on an inclination beyond its power, should be worked backwards and forwards until sufficient momentum be acquired for surmounting the next summit.

This is an operation not only of time, but in many cases would be imminently dangerous, and could not fail to be a continual source of annoyance.

When it is stated that the risk of accident would be increased, it must not be inferred that increase of speed is attended with greater frequency of accident, but rather that such mishaps are likely to be more extensive and serious when they do occur.

I now come to consider more immediately the chief object of the memorial which has been laid before the directors, viz: The expediency of making an experiment on the London and Birmingham Railway, extending over a distance of eight or ten miles, as suggested by Dr. Lardner and Dr. Dalton.

In recommending the directors to make such an experiment, those gentlemen have evidently been influenced by the statement in the memorial that it would not cost over £500, and that the experiment,

should it fail, would be productive of no detriment to the Railway Company.

I have thoroughly considered the expense of such an experiment, and also the probable inconvenience that would arise out of its failure, and supposing the latter result, I am satisfied it could not cost the Railway Company less than £8,000 or £10,000; and this sum may be made to appear without taking into the account many contingencies that would necessarily attend such a circumstance.

The ballasting and laying the rails alone costs from £800 to £1000 per mile, and this charge must unquestionably be incurred in merely transforming the undulated surface to an uniform one. The embankments would require to be brought to a higher, and excavations to a lower, level; thus interfering with the whole of the bridges, over and under the railway.

In short, you could only prepare for the contingency of a failure, by erecting temporary bridges over the railway, throughout the ten miles, until the utility of the scheme had been determined.

These and other considerations, connected with the detail of executing the railway, which it would be superfluous to enter into here, and which it would be impossible to render intelligible in a report like the present, fully convince me that it would be at least rash to advise an expensive experiment on the London and Birmingham Railway, which, in any event, could only save a very small sum in the original expenditure, with the possibility of your not succeeding to your expectations; thus producing a result fraught with mischief to the undertaking generally.

I feel it, however, due to Mr. Badnall, to state that I consider a trial upon some branch road might be made with advantage, as the adoption of his ideas would certainly be productive, in many cases, of considerable saving in the first cost, which, in some branch roads, is of paramount importance.

I must, however, again repeat, that no saving of power could be by any possibility effected.

ROBERT STEPHENSON.

Note relating to the hardening of Lime under Water, by the action of Carbonate of Potassa, &c., and to the hardening of Carbonate of Lime in the Air, by Potassa and Soda. *By* A. D. BACHE, *Prof. of Nat. Philos. and Chem., Univ. Penn.*

The following experiments were made more than eighteen months since, and were suggested particularly at the time by the article of Professor Emmett, on the solidification of raw gypsum in the air, by the action of the alkali, potassa, and of certain of its salts. They commenced with an examination of the effect of certain salts of potassa and soda, and of caustic soda, on the hardening of carbonate of lime, and of common lime, in the air; and, by a natural transition, to a more interesting subject, the effect of these, and of other materials,

on the hardening of lime under water. Not having leisure to prosecute this subject, I am induced to publish the results already obtained, that by attracting the attention of some one who may be favourably situated for carrying out the course of experiment which they suggest, it may be carried forward to completion. The conclusions cannot fail to be of interest, both in a practical and theoretical point of view.

It is well known that certain impure limestones yield, when calcined, a lime which hardens under water, technically called hydraulic lime. Experimenters, who have examined these lime-stones, with a view to determine the ingredient giving this hydraulic property, have not agreed in their conclusions; the essential ingredient has been in turn supposed to be silica, alumina, oxide of iron, and oxide of manganese. My friend, Col. Totten, informs me that Col. Troussat, in a recent work on mortars, attributes this power of conferring hydraulic properties upon lime, in certain cases, to soda—an ingredient which, before his examination, had not, I believe, been detected in any hydraulic limestones.

The method of ascertaining the effect of the substances experimented upon, in causing lime to harden under water, was similar to that employed by Raucourt, and described in his work on mortars. The mixture having been made, and brought to a paste of a proper consistency, was placed at the bottom of a glass vessel, and water poured gently upon it. A wire stem, terminated at one extremity by a wooden disk, was placed vertically upon the mixture in the vessel, and the weight ascertained which was required to pierce the mass; the hole thus made being filled up, by tamping the mixture with a blunt stick, it was allowed to remain exposed to the action of the water for any desired length of time, and then subjected again to a similar trial.

As almost all common lime is slightly hydraulic, an examination of that to be used in the experiment was first made; having been slaked, and, when made into a thick paste, placed at the bottom of a wine glass, and water added, the test stem was applied, the mixture having set, bore 1 oz. troy upon the head of the stem; after an exposure of one day, the mass bore $1\frac{1}{2}$ oz.; and after two days, bore $3\frac{1}{4}$ oz.; it had then been so far disturbed, that it would not resume its cohesion.

This *common lime* was thus shown to *possess feeble hydraulic properties*. When mixed with sand and water, so as to form a tolerably rich mortar, the mass, after it had set, bore $5\frac{1}{4}$ oz. on the rod, and, after two days, 7 ounces, which was the maximum weight borne. In *its mixture with sand*, this lime formed a *mortar which was feebly hydraulic.*

Some of this lime was mixed with caustic hydrate of soda, which, however, had a portion of adhering carbonate. The proportion of soda added was not particularly attended to; it was, however, much less in weight than the lime. The mass became so soft, that when, after tamping in the bottom of the glass, water was added, the test rod penetrated it freely. After one day, the mixture bore 4 oz. troy, upon

the wooden disk at the top of the rod; after another day, $5\frac{1}{2}$ oz., which was the maximum. It recovered this strength twice, by the interval of a day between the times at which it was disturbed by the penetration of the rod. *Soda*, it then appears, renders lime, to a certain extent, capable of setting under water.

Lime being made into a paste, with soda and water, acquired considerable consistency in the air.

When lime was made into a thick paste, with a solution of carbonate of soda, and exposed to the air, it crumbled into dust; this being mixed again with water, assumed consistency at first, but subsequently crumbled.

Lime did not set in the air, when mixed with a solution of sulphate of soda; the incoherent mass was pulverized, and reset with water, which increased the cohesion, but not very materially. Under water, the paste of lime and sulphate of soda, four parts of lime by weight, and one of sulphate of soda, bore 9 oz.; but on the next day lost its cohesion.

Carbonate of potassa, mixed with lime, in the proportion of six, by weight, of the salt, to two of lime, formed a mass which crumbled in the air; but, being reset with water, assumed considerable cohesion.

This same mixture had hydraulic properties; for 4 oz. of lime, 2 of carb. potassa, and 11 oz. of water, being mixed and placed under water, bore, after two days exposure, 64 oz., or $5\frac{1}{3}$ lbs., which was all the weight which was at hand. A mass of the same mixture, which had been exposed to the air, and was but slightly coherent, being placed under water, became quite hard.

An attempt was made, by reducing the proportion of carbonate of potassa to about 12 per cent., to harden the lime in the air; but it did not succeed.

A curious effect was produced by *soda*, and by *potassa*, on *carbonate of lime*, reduced to powder, and, after mixture with alkali and water into a paste, exposed to the air. The carbonate became, in one case, harder than the original material, and in another, but little inferior to it in hardness; in the former case, the experiment was made upon chalk; in the latter, upon Carrara marble. The marble had very nearly the appearance of the original material, and a cast taken from it would have had a beautiful appearance, very different from the dull white of plaster of Paris. Neither of these mixtures was hydraulic; and when a mass of chalk and soda, which had hardened in the air, was placed in water, it was completely disintegrated.

I had, at the time of making these experiments, a quantity of silica, which had been prepared by passing fluo-silicic acid into water, and which, never having been heated, was still soluble, though, of course, in a small degree; after repeated washings, it still restored the red colour of alkanet, which had been rendered purple by a feeble alkaline action. This silica was mixed with lime and water, so as to form a paste, and being placed under water, would not bear the weight of the test rod; it was exposed for four days, and was softer, at the end of the trial, than at the beginning.

Notes of an Observer.

Remarks on Professor Olmsted's Theory of the Meteoric Phenomenon of November 12th, 1833, denominated Shooting Stars, with some Queries towards forming a just Theory. *By* James P. Espy.

In the American Journal of Science and Arts, vol. xxv. page 363, Prof. Olmsted has given a very extensive and interesting account of the most beautiful meteoric phenomena of shooting stars, which appeared in the night of the 12th November, 1833. And in the next volume, page 132, the Professor endeavours to prove that "these meteors consisted of portions of the extreme parts of a nebulous body, or comet, which revolves round the sun, in an orbit interior to that of the earth, but little inclined to the plane of the ecliptic, having its aphelion near the earth's orbit, and having a periodic time of 182 days, nearly. That these meteors were combustible, and fell by the force of gravity from the place where they emanated, above the surface of the earth about 2238 miles, and consequently entered the atmosphere with a velocity of 4.1 miles per second." That this great velocity would cause the air before the motion to be condensed, so as to be equal to common atmospheric air at the surface of the earth, when the motion reached within thirty-five miles of the earth. That the temperature of this condensed air would then be 46080 centigrade, according to a formula given by Leslie, whom he quotes as saying, "On account of the increase of capacity for heat which air undergoes by rarefaction, the absolute quantity of heat contained in a given volume of atmospheric air, is the same at all elevations above the earth."

Now, I cannot assent to this theory, because meteors could not fall on the side of the earth most distant from the sun, from any body moving round the sun interior to the orbit of the earth. But the meteors were in the night, and consequently on the side of the earth opposite to the sun, which a body moving round the sun, interior to the earth's orbit, could not be. This objection would not have been fatal, if the Professor had placed the aphelion of his comet exterior to the earth.

Again, these meteors could not have fallen from a comet only 2238 miles from the earth's centre, for then the whole comet would have fallen, even if it had been more than twenty-nine times as far off as the Professor has placed it.

Again, these meteors could not have fallen from a comet, if they had been actuated by the force of gravity alone, for then they would have fallen perpendicular to the surface, which they did not do.

I do not understand whether the Professor means that all the meteors emanated from one point in the comet, or from a space equal to, or larger than, the surface of the earth over which they fell. But in either case they would not correspond with the phenomena, for in both cases they would fall perpendicular to the surface of the earth; and there could be no inference drawn from the radiating point, as it is called, concerning the elevation of the comet from which they emanated. It is known that the meteors pretty generally fell to-

wards the horizon, in such a manner that if their paths were traced upwards, they would all meet in the same point, and this was called the radiating point. This, however, was not the case universally, as will be seen hereafter.

Again, if this radiating point depended on a comet, whose revolution round the sun was 182 days, it could not have been stationary among the fixed stars; for its velocity in its orbit, when it was 2238 miles from the earth, would be about 5000 miles an hour slower than that of the earth. Nor can any comet, whose periodic time is 182 days, appear stationary among the fixed stars in aphelion, whether that aphelion is exterior or interior to the earth's orbit.*

These objections appear fatal to the theory advanced by Professor Olmsted; but there are others also which would of themselves render that theory highly improbable.

It cannot and does not even pretend to account for the meteors, in some regions of the meteoric shower, appearing to move in all directions, horizontally, and even upwards.

It cannot and does not even pretend to assign any reason why the auroral light, which was seen at many places very distant from each other, was not seen at all intervening places, as it should have been if it had been 2238 miles above the surface of the earth. It certainly was not seen at Philadelphia before ten o'clock, as I looked out for it very anxiously, for a reason which will be mentioned hereafter; though it was seen not very far from the city, as will appear from the following statement, which was procured for me by Dr. Emerson, of this city:

"A gentleman in the Delaware bay, about eighty miles south of Philadelphia, observed a cloud of an unusual, round, and well-defined appearance, rise in the west, about seven o'clock on the evening of the 12th November. Its height was inconsiderable, and its length, to use his own expression, did not seem to be more than 200 yards. Soon afterwards, streaks, or flashes, of light began to dart, apparently, from behind the cloud, similar to what we see in the aurora borealis, which it resembled. This illumination continued in a most brilliant manner for an hour or more, when it began to blow with such violence, directly from the cloud, that he was apprehensive the vessel would drag her anchors. The subsequent phenomenon of the meteors was of the greatest brilliancy—the stars, or balls, streaming, and seemingly falling, in every direction."

It is highly probable that this cloud, and the luminous flashes which appeared behind it, were in the neighbourhood of each other, particularly as the luminous appearance was not seen at Philadelphia, and as many such were observed in various directions and elevations, in different parts of the United States.

At Dover, N. H., there was an appearance of the aurora borealis

* Indeed, the aphelion and perihelion of a comet, whose periodic time is 182 days, are two points at which the comet could not, if near the earth at these points, be made to move with a velocity equal to that of the earth. Other points might be chosen in the comet's orbit, contrary to the Professor's assertion, in which its motion would be equal to that of the earth.

early on the evening of the 12th, which continued till four o'clock in the morning, when it suddenly broke out into streams of strong light, spreading into columns, changing into a thousand different shapes, varying their colours through all the tints of the rainbow, and shooting from the horizon almost to the zenith. This scene was followed by a splendid exhibition of fire-works. Luminous balls might be seen darting *about* with great velocity, leaving behind them a train resembling that of a comet. The whole was closed by the formation of a triumphal arch, which vanished before the coming light of morning.—[*Professor Caswell.*

Captain Gideon Parker was in the Gulf of Mexico, lat. 26 N., long. 85½ W., and before three o'clock on the morning of Nov. 13, noticed several meteors, but not more than he had often seen before. Heavy dark clouds hung low in the north-east, from which the second mate, (who held the watch before Captain P. came on deck,) said that the first meteors he saw seemed to break like lightning.

Above the clouds, which were from 15° to 20° high, the sky was clear, and the stars as bright as usual. About three o'clock, Capt. P. first noticed the unusual number of falling stars, and began to count their number, but was forced to desist by their rapid increase. Captain P. observed them for an hour and a half; during that time, they were seen only in the north-east, above the cloud, and the eye at first would take in nearly the whole space of their action, which extended six or seven points along the horizon, and about 45° in altitude; but towards the latter part of the observation the space was extended, say twelve or fourteen points horizontally, and a few degrees higher in altitude.

During his whole period of observation, *not one was seen in the west*, although Capt. P. looked particularly to this fact, and called the mate's attention to it at the time. Captain Parker distinctly remembers a radiant point in the north-east, from which all the courses were directed, some shooting horizontally, some vertically, and others at all inclinations between the two, but none upwards; some shot towards the north, and some towards the east. This radiant point at first held 45° of altitude, but seemed to rise 5° or 10° in the period of his observations, without, however, moving at all from the north-east.

All that descended low enough, passed behind the cloud; not one between the cloud and the observer. All, both large and small, left luminous traces, in which no prismatic colours were observed; and no one of the traces was observed to continue more than two seconds. The afternoon of the preceding day had been squally, and wind variable; but at the time of observation the wind was gentle, from the north-east. At nearly half-past four o'clock, Captain P. yielded the deck to his mate, who states, that soon after he came on deck, the stars appeared passing over from the north-east into the west. In the west, their courses were very short, and they seemed just to let go their hold. The ship was heading south-east. He continued on deck till eight o'clock, A. M. In the meantime, the meteors in-

creased in number, and spread over the whole heavens, and were most brilliant about six o'clock. The sun rose at half-past six.

Now, it is highly probable that all auroral lights—the triumphal arch, the luminous, and even the non-luminous, clouds from which luminous flashes appeared to proceed on that night—were but variations of one and the same magnificent meteoric display; I cannot, therefore, assent to any theory which affords no clue to an explanation of parts of the phenomenon so important. Of luminous clouds, several were seen; one at Poland, Ohio, was visible in the north-east for more than an hour. The Hon. Calvin Pease discovered it, at four o'clock, near the star Alioth, in Ursa Major. It was then very brilliant, in the form of a pruning hook, and apparently twenty feet long, and it gradually settled towards the horizon, until it disappeared. He saw it at five o'clock, when it resembled a new moon, two or three hours high, shining through a cloud; about fifteen minutes afterwards, no vestige of it could be seen. At Niagara falls, also, there was seen, a little after two o'clock, a large, luminous body, like a square table, nearly in the zenith, which remained for some time nearly stationary, and from it were emitted large streams of light.

It is true, Professor Olmsted inclines to the opinion that many of the auroral lights which appeared before and after the 13th, were the comet from which the meteors in question proceeded. But as many of them certainly were not referable to a comet, having appeared, some of them in the south-west, and even in the south-east, and at very different elevations, even in the same neighbourhood, it is very improbable, from this circumstance alone, that any of these lights had their origin in the tail of a comet; and this improbability rises to certainty, when we consider that the same auroral appearance did not present itself, on the same night, all over the United States.

One of these auroras, at least, must have been very low in the atmosphere, on the night of the 12th of June, for it was very faint, and not more than 15° high, at Philadelphia, at 10 o'clock, when, at the same time, it was very bright, and at least 45° high, at Germantown, not six miles distant. Indeed, so faint was it at Philadelphia, that it would not have attracted notice, had I not anticipated it from the state of the dew point; and even after I pointed it out to my friend, Professor Bache, he was at first disposed to doubt whether it was auroral or not, but afterwards yielded assent, though no effect could be detected on the magnetic needle. I afterwards saw the lady who furnishes the meteorological table for this journal, who described the appearance to me as highly brilliant, covering the whole north-west and north, and reaching at least 45° high. The upper part of this aurora could not, therefore, have been more than $2\frac{1}{10}$ miles above the surface of the earth.

This agrees well with the height of auroral arches, as calculated in this journal, vol. xiii. page 294. We shall see hereafter how it agrees with the height of meteoric fire balls. We shall also mention more particularly the aurora of the 8th of March, seen at New Haven, but not at Philadelphia.

Again, I cannot give my assent to the cometic theory, because it cannot account for the curved appearance of many of the largest meteors; it is true, their tracks were generally straight, but on this theory they should all have been so. The following is a description, by an eye witness, of one which was seen in this state; it was given to me two or three days after the phenomenon occurred.

Nov. 13th.—About five o'clock, or a few minutes before, I was standing looking at the meteors, when my attention was called to a very large, bright one, near the zenith, which shot from the north-west towards the south-east. It was very much larger than either of the others, and it was the only one which moved in a serpentine direction; its motion, like the others, was slow enough to trace the direction with ease. But the most remarkable difference between this and the other meteors, was, that after it shot out its full length, there remained a serpentine streak of light, quite as bright as its first appearance, for at least a minute; this streak was a steady, bright light, which neither increased nor diminished for this length of time; after this it began to diminish, and in a short time, a little less than a minute more, nothing remained visible of it but a kind of smoke, or vapour, which gradually changed its form, spreading out and circling up. I am sure the time is not overrated, as it lasted nearly all the time the stage horses were changing, and the vapour was still visible when we started, which must have been at least six or seven minutes after the first appearance. The place of observation was about fourteen miles south of Harrisburgh, on the Susquehanna. The curve was similar to those of a large snake, having several bends, and it did not change its shape or direction during the first minute and a half.

Again, I cannot give my assent to the cometic theory, because there is no satisfactory account given of the manner in which the meteors were ignited. It is true, the velocity with which they are supposed to have entered the atmosphere, by falling a distance of 2238 miles, would have been sufficient to produce a great condensation of the air underneath them, on a supposition that they were bodies of moderate weight and consistency; but this they could not be, as they were supposed to fall from a comet, composed of such light substance as to afford, by its attraction, no retarding influence to the fall of the meteors towards the earth.

But besides this, the Professor has committed a singular error in calculating the degree of heat produced by the condensation of air in the upper regions of the atmosphere. Indeed, so fallacious is the result of the calculation, that I should suppose it was caused by some typographical error, if the whole language of the author did not forbid the conclusion. After quoting a formula of Leslie, for calculating the heat extricated from air condensed, these are his words: "On account of the increase of capacity for heat, which air undergoes by rarefaction, the absolute quantity of heat contained in a given *volume* of atmospheric air is, according to Leslie, the same at all elevations above the earth." The Professor then calculates by the formula, that the heat extricated when the air before the meteor has acquired com-

mon atmospheric density, (which he supposes it would do at the height of about thirty-five miles,) would be 46080 degrees centigrade. "This is the amount of heat which would be extricated by the condensation of air, as it exists at the height of thirty-five miles; but the compression supposed is not that which results from air of this density, but from such as is less dense, commencing from that which is of an extreme degree of rarefaction. The amount of heat, therefore, would be greater than the estimate here made."

Now, one of two things is certain; either Professor Olmsted has mistaken Leslie's meaning, and used the word *volume*, instead of *weight*, in the above quotation, or Leslie was himself most egregiously wrong in his assertion. When the capacity of air is said to be increased by rarefaction, it is not meant bulk for bulk, but weight for weight; and according to the doctrines which prevailed at the time Leslie wrote—first, I believe, taught by Dalton—air, at all elevations, contained the same quantity of caloric, weight for weight. This was known to be true of aqueous vapour, or steam, at all temperatures, and it was thought to be true of all gases; and such, it is believed, is nearly the fact. If this law were strictly true, the temperature of the air, which is stated by the Professor, at 46080° centigrade, would not be 50°, under the most favourable circumstances which could be proposed; for the air at the surface of the earth, when it is of the density in question, never reaches this temperature.

But there is another view of the subject, which shows the absurdity of the above calculation. Whatever increase of temperature takes place in the condensation of air, the same diminution must take place in rarefaction; and therefore, if, by condensing air, taken at the elevation of thirty-five miles, into air of equal density as that at the surface of the earth, its temperature would be increased 46080° of the centigrade scale, its temperature would be diminished the same number of degrees by restoring it to its former state of rarefaction. Or, in other words, if a portion of air at the surface of the earth, at zero, were rarified 1024 times, its temperature would be 46080° centigrade below zero; and if this air, so rarified, were raised in temperature to zero, and then condensed into common atmospheric density, its temperature would be 46080° centigrade.

If this were really the case, nothing would be more easy than, by means of rarefying, and then condensing, the air, to produce a temperature many thousand degrees both higher and lower than has ever yet been obtained.* The exact law of increase of temperature by the condensation, of air varying in density, at the commencement of the experiment, has not, so far as I know, been ascertained. Mr. Ivory says, that if air at common density be condensed into one-half the space, its increase of temperature will be 90° Fahr. But it is known, that if air of less density is employed in the experiment, the increase of temperature will not be so great; how great, is not precisely known; but if we reason from the analogy of steam which is known, when air of half

* It is indeed not a little remarkable, that Mr. Olmsted never seems to have thought of the temperature of the air at the beginning of the condensation; he certainly nowhere mentions it.

the density is employed in the experiment, and condensed into half the space, the increase of temperature will be only 78°. For if steam, at common atmospheric pressure, be doubled in density, its increase in temperature is about $37\frac{1}{2}$; whereas, if steam, at half atmospheric pressure, is doubled in density, its temperature is increased only $32\frac{1}{2}°$ — $\therefore 37\frac{1}{2} : 32\frac{1}{2} :: 90 : 78$ = to the increase of temperature which air at half atmospheric density would have, if its density were suddenly doubled.

Again, I cannot embrace the cometic theory, because it does not account satisfactorily for the remarkable change of temperature which accompanied the phenomenon. The Professor, it is true, mentions as a possible cause, that "the air descended in large quantities from the regions of perpetual frost."

In making this statement, Mr. Olmsted must have entirely forgotten the result derived from Leslie's formula—that air brought down from the upper regions of the atmosphere, and condensed into common atmospheric density, would have a temperature of 46080° centigrade; upwards of 78000° Fahr. The probability is, that if air were brought down from any elevation to the surface of the earth, its temperature would be greater than the air at the surface; for as there is a great deal of latent caloric given out by vapour in the region of the clouds, when rain is formed, and as this caloric is absorbed by the air,* then it follows, that each pound of air, in that region, probably contains more caloric than a pound of air at the surface of the earth. This probability is rendered almost a certainty, from the following fact. Gay Lussac ascended into the air 7600 yards. He found that the air at that elevation was exactly one-half the density of that at the surface of the earth, and the temperature had fallen 72° of Fahr. But it has been shown in the foregoing, that if air of common density was suddenly rarefied to one-half the density, it would probably be reduced in temperature 70°. One thing, however, is certain, independent of all experiment: that air being brought from upper to lower regions, would not be colder than the air into which it was brought; for if it was, the atmosphere would be in a state of unstable equilibrium, and a vortex would be formed of cold and heavy air from the upper regions downwards, which would never cease till the atmosphere was inverted, the lower air, having the most caloric, taking the place of the upper, and the upper taking the place of the lower. This is not the constitution of the atmosphere, yet we will show here after some extreme cases, where vortices will be formed both up and down. In short, if Dalton's theory is correct, no change of temperature at the surface of the earth would take place, by air from the upper regions being forced down by meteors; and if Ivory is right, a small increase of temperature would take place. A sudden production of cold, therefore, is *not* an effect which would follow, of course,

* Sufficient in a rain of one inch to heat the whole upper half of the atmosphere 20° Fahr., on a supposition that the capacity of air is 1-4, and the latent caloric of steam is 1000.

from the descent of large quantities of air from the regions of perpetual frost.

The Professor observes, in a note, that "the heat extricated by condensation might be supposed as equivalent; but this, when produced by sudden compression, would not heat a gaseous medium, which is the worst of all conductors of caloric, but it would escape by radiation."

This explanation is altogether unsatisfactory, for it is the gaseous medium itself which is heated by compression; and besides, we have reason to believe that air is quite as bad a radiator as it is a conductor of caloric; for Dr. Wells says he has seen a thermometer 16° lower, at the surface of the ground, a little after sunset, than one placed only a few feet above it; and I have seen a difference of 11° in similar circumstances, which could not be, if air was a good radiator; for in that case the air would become cool, by radiation, as soon as the surface of the earth. Indeed, we are led to believe that air is almost a non-radiator, when we consider that in a calm, clear night, air at the height of twenty or thirty feet, will remain for hours at nearly a constant temperature of eight or ten degrees above the temperature of the surface of the earth, and 100° above that of the celestial spaces; for the temperature of the celestial spaces is probably a little less than the lowest temperature ever witnessed on the surface of the earth, as it is not likely the surface of the earth would cool down by radiation, quite so low as the temperature of the space surrounding it. Fourier, by a profound investigation, makes this temperature 57° or 58° below zero of Fahr. But even if the Professor is correct in principle, when he asserts that air brought down from the regions of perpetual frost will diminish the temperature at the surface of the earth, it would not apply to the present case, unless we suppose the effect prior to the cause; for in almost all instances, the temperature had sunk rapidly many degrees, previous to the meteoric shower, which was alleged to be the cause of the descent of large portions of the atmosphere.

Mr. Olmsted is not more successful in his attempt to explain the west wind which prevailed. He says, that "so great a number of bodies, some of which, it appears, were very large, falling through the atmosphere, with so prodigious a velocity, must have produced extensive derangements in the atmospheric currents. The first effect was a westerly wind, which suddenly *succeeded* the meteoric shower, in nearly every place where the shower prevailed. Large volumes of air, suddenly driven from the upper to the lower regions of the atmosphere, must have a relative motion eastward, since the velocity due to their greater distance from the earth, derived from the diurnal motion, would not be instantly lost on their descending to a lower level. In our latitude, a body of air descending suddenly to the surface of the earth, from the height of twenty miles, would have a relative velocity eastward of five miles per hour." Now, it is very remarkable that almost all the authorities referred to by the Professor, directly contradict his statement that a western wind *succeeded* the meteoric shower; they say this wind *preceded* it.

Alex. C. Twining, of West Point, says there was a moderate breeze from the north-west; the day *preceding* had been marked by violent gusts of westerly wind, one of which threw over and sunk, opposite to this place, a two-masted vessel, with such suddenness, that all on board perished. The Professor's own observations are, that *on the 12th a high westerly wind prevailed by gusts.* Dr. Humphreys says that at Annapolis, Md., the wind at first, on the 12th, blew from the south, but veered suddenly, and for the rest of the day was quite fresh from the north-west; at the time of the meteors, the air was tranquil; on the 13th, it blew from the south, nearly as strong, but not so cold. At Charleston, S. C., the wind *continued* from the *north-east* during the 13th. At Buffalo, the winds, which had been very heavy for many hours, had abated considerably. At Poland, the weather, which had been mild, at the approach of evening, on the 12th, became clear, and so cold, that before morning the mud froze in the streets.

Mr. Palmer, near New Haven, says that the wind was west on the 12th, at six o'clock; at seven, it was south-west, accompanied with a reddish vapour, which gradually rose up to the zenith, and prevailed during the first part of the meteoric display. From three till four, the air was still; at four, a strong gust of wind blew for a short time from the north-west, and immediately afterwards the meteors increased astonishingly; these gusts returned at moderate intervals with less and less force, each time occasioning a perceptible increase of meteors. Dr. Ashbel Smith, of Salisbury, North Carolina, describes the air as becoming more dry and harsh during the meteoric display. This state of it, he says, rapidly increased, and, on the *15th*, it was very keen and cold, with high dry winds. These are the chief authorities to which Mr. Olmsted refers, to prove his assertion that a western wind suddenly *succeeded* the meteoric showers; not one of which gives the slightest countenance to such an idea. But is the principle itself correct? If large masses of a comet, just such as the Professor describes these meteors to have been, were to fall through the atmosphere, bringing down with them large quantities of air, from the highest regions of the atmosphere, to the very surface of the earth, would this produce a western wind? Most assuredly not; for these foreign masses entering our atmosphere, without partaking of the rotary motion of the earth, would incline towards the west in their descent, and, by their inertia, put the air in motion, and thus cause an *eastern* wind.

Now, as the meteors over a large extent of country did actually slope towards the north-west, and as no south-east wind was produced, this is an absolute proof that no foreign bodies of sufficient weight and consistency to drive the air before them, down to the lower regions of the atmospere, did fall from a comet, or any other body, into the air, during that memorable night.

If it were possible to imagine a portion of air brought down from the height of twenty miles to the surface of the earth, through a vacuum, it would be found moving five miles an hour easterly, as the Professor says; but as this could not be in fact, and as the only thing

possible in this case is to suppose that air descended through air, and that as much ascended as descended, and that this ascending air would have as much motion westerly as the ascending air has easterly, we are compelled to acknowledge that these two motions would counterbalance one another, and thus no horizontal wind would be produced by the simultaneous transfer of air from the upper to the lower, and from the lower to the upper, regions of the atmosphere. And that the transfer is simultaneous when air comes down, is manifest; for if any portion is forced down, this will force an equal quantity up, however great or small this portion may be.

But there is another circumstance which, of itself, completely refutes the notion, that these meteors were foreign bodies, falling into the atmosphere by the force of gravity, and condensing the air before them so as to produce ignition.

For if this had been the case, the velocity of the meteors would have diminished constantly from the moment of their first appearance till their final extinction; because the air, at the moment of inflammation, must have been condensed at least seven times beyond that at the earth's surface; M. Collardon, Repertoire de Chemie, says thirteen times, for even spunck in the fire pump does not ignite with a less density; and consequently it must have been pressed upwards with a force of at least seven, perhaps thirteen times, fifteen pounds, to every square inch of its under surface; and this great pressure would, most undoubtedly, have rapidly diminished the meteor's velocity, even if its density and specific gravity had been much greater than they were supposed to be. Therefore, as the velocity of the meteors, at least generally, was uniform, till the very moment of their extinction, they could not have been bodies falling, by the force of gravity, and condensing the air before them. And indeed, if it did not appear invidious to assign more reasons on this point, when enough have been given to disprove the theory, it would be easy to show that if the velocity of the meteors was as great as the Professor calculates them to be, they could not have entered very deep into our atmosphere, before the density of the air before them would have been fifty, or even one hundred, times greater than that of common air at the surface of the earth; so that, unless the meteors were much denser than they were supposed to have been, they would have been thrown upwards again with considerable velocity, by the reaction of the expanding air. This effect will be admitted the more readily, when it is considered that the meteors became lighter and lighter from combustion, till the very moment of their extinction. Besides, it is known—so says Mr. Adams, in his Natural Philosophy—that light bodies, such as mustard seed, when discharged from a musket, with strong powder, sometimes fly back in the discharger's face; and the velocity of the meteors, if they fell 2238 miles by the force of gravity, must have been eight or nine times greater than that of the mustard seed.

From the reasons assigned, then, we may safely infer that *the meteors of the 13th November, 1833, were not bodies falling towards the*

earth by the force of gravity, neither from within, nor from without the atmosphere.

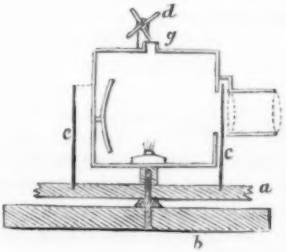
[TO BE CONTINUED.]

Description of an improved form of the Slides for Magic Lanterns.

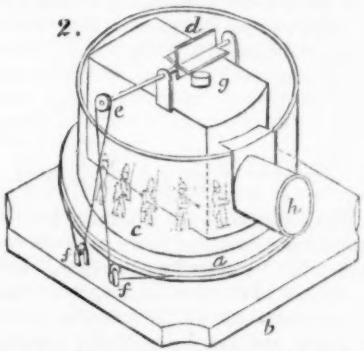
TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN,—I send you a description of an improvement in the Magic Lantern, made by me in 1825, an account of which has not been published in any work. By a slight alteration, the common form of lantern may be adapted to them. In the accompanying figures similar parts in each are explained by the same letters of reference.

Fig. 1



2.



The pulley, *a*, should be larger than the bottom of the lantern; the arbour around which it works is secured to the base, *b*; and after passing through the pulley, is received in a socket fastened to the bottom of the lantern; on this pulley there is placed a band of glass, *c*,* which is kept in its place by fitting into a groove turned in the upper side of the pulley; the figures to be exhibited are painted on the glass, in the same manner as those on the common slides. On the top of the lantern, a fan, *d*, is placed, so that the leaves on one side of the centre will be acted upon by the rarefied air passing up the chimney; at one end of the spindle of the fan, there is a small pulley, *e*, over which an endless cord passes, and connects it with the pulley *a*; the intermediate pulleys, *f f*, are for the purpose of changing the direction of the cord, so as to admit of it passing around *a*.

Now, it is evident, that when the lamp in the lantern is lighted, and a current of heated air passes up the chimney, the fan will revolve, and motion will be communicated to the band of glass on the pulley, *a*; and that the figures will be represented (on the screen) in succession, as they are painted on the glass.

In exhibiting, to give the greatest effect to the deception, have a hood placed over the lantern, with a cord leading from it over pulleys, fastened to the ceiling at a back part of the room. When the

* The bands of glass may, of course, be as large in diameter as it is possible to procure them, and the pulley made of sufficient size to suit them.

audience are seated, and the lights extinguished, by raising the hood quickly, it will appear to those not in the secret, to be the work of enchantment. As soon as the figures have all passed, lower the hood over the lantern, change the band of glass for another, and so on to the end.

The above arrangement admits of a more perfect action than the old plan; for instance, there may be a stationary slide, with a road, &c. painted on it; and on the band of glass, a troop of horse may be represented, which will have the appearance of travelling over the ground; the effect may be heightened by the under side of the pulley, near the periphery, being fluted in radii, by fixing a pin directly under the tube of the lantern; the pulley, in passing over it, will receive an undulating motion, which will be communicated to the figures on the glass. Fig. 1st, is a longitudinal section, taken through the centre. Fig. 2d, a perspective view of the lantern and its appendages. Yours respectfully,

A. C. Jones.

Alleged Error in Arnott's Physics.

The Journal of the Franklin Institute would have an increased interest if it contained more original matter. It has obtained a standing rather too "correct and proper," for those who are not veterans in science to adventure their speculations. With this impression, and hoping that this will be noticed, I submit the following.

There are (as I conceive) several erroneous positions taken in "Arnott's Physics." That now presented may be found at page 134, Carey & Lea's edition of 1831. It is there stated, that "when any elastic body, as a billiard ball, strikes any other body larger than itself, and rebounds, it gives to that other body, not only all the motion which it originally possessed—this being done at the moment when it comes to rest—but an additional quantity, equal to that with which it recoils." Also,

"This phenomenon constitutes the paradoxical case, of an effect being greater than its cause, and has led persons imperfectly acquainted with the subject, to seek from this principle, a *perpetuum mobile.*"

In opposition to the above, I contend, that when any elastic body strikes any other, larger than itself, and rebounds, it does not give to that other all its motion, by just so much as it *does* rebound.

Will some of your readers show that Dr. Arnott is right, and that I am wrong? T. W. B.

Cincinnati, 8th Oct., 1834.

Our respected correspondent is *certainly* wrong in his complaint of a want of original matter in a journal, more than two-thirds of each number of which are thus occupied; he must strangely have overlooked the valued labours of the editor, in his monthly remarks upon patents. We *trust* that he is also wrong in supposing that a journal intended to give useful information to mechanics, can possibly attain a stand-

ing too "correct and proper" to meet their encouragement, and that they would desire its scientific tone to be lowered. COM. PUB.

FRANKLIN INSTITUTE.

Monthly Conversation Meeting.

The second conversation meeting of the Institute, for the season, was held at their Hall, Oct. 23d, 1834.

Messrs. Carr & Lunt exhibited a variety of articles, of excellent workmanship, or of ingenious construction, consisting of a ship's windlass, invented by Walker & Badger, of Portsmouth, New Hampshire; two rack wrenches, manufactured by H. Foote & Co., of Springfield, Mass.; specimens of manure forks, from the same manufactory, remarkable for their excellent temper; and samples of wood screws, by J. G. Pierson & Brothers, of New York—beautifully finished articles, which were pronounced by persons, who are in the practice of using them, as equal to the best specimens ever exhibited in this country.

Mr. L. Hammond, of Middletown, Connecticut, showed a safety door lock; the letter principle being applied differently from the similar one in Perkins' lock. The bolt is secured by tumblers inside, and can be released by drawing some of a series of pins, of which there are twenty-four, marked with the letters of the alphabet. The lock may be set to any letter or word, and can be locked, or unlocked, only when the pin, or pins, corresponding to that letter, or word, are withdrawn.

Mr. Joseph Nock, of Philadelphia, brought forward a safety chest lock, which was admired for its ingenuity and workmanship.

Prof. A. D. Bache presented to the meeting, in the name of Mr. Thomas Ewbank, of New York, a metallic syphon, of the form described by Mr. Ewbank, in the Journal of the Institute, vol. xiv., page 367, and showed its application as a cock, or as a gauge, pursuant to the views of the inventor.

A galvanic battery of four elements, the invention of Mr. John W. Draper, of Christiansville, Virginia, was exhibited, and its decomposing powers illustrated. This battery is described in the Journal of the Institute, vol. xiv. page 289; and the conditions of most powerful action, as determined by the inventor, were stated by Prof. A. D. Bache.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Mr. J. D. Woodside's Revolving Harrow and Seed Cart.

The Committee on Science and the Arts, constituted by the Franklin Institute, of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a revolving Harrow and Seed-cart, invented by Mr. James D. Woodside, of Washington city, District of Columbia,

REPORT:—

That having examined a model of the machine, and inspected nu-

merous certificates of its performance, which have been given by agricultural gentlemen, they are of the opinion that this is a valuable improvement in that necessary implement of husbandry, the harrow.

Some of the committee were present during a trial of one of these machines, the result of which was highly satisfactory. It seemed on that occasion to require more power to move it than the common harrow; but its superior efficacy in eradicating weeds, and pulverizing the soil, will, it is believed, more than compensate for this difference, as it will certainly do more work at one operation, than the common harrow will at two or three.

Another advantage which it possesses, is, that it is not so liable to be clogged or choked by weeds, and clods of earth, as the common harrow. These are collected by the latter; and wherever the harrow is raised to clear it of them, there remains a heap of rubbish, which impairs the evenness of the field, and injures the crop.

The committee have not had an opportunity of seeing the seeding apparatus in operation; but from an inspection of it, they believe it will be found to answer very well for smooth and heavy seeds, such as clover seed, and wheat or rye, as it will, if properly regulated, distribute them more evenly than can be done by hand.

Accompanying this report, is a description of the machine, which has been furnished by the inventor.

By order of the Committee.

Oct. 9th, 1834. WILLIAM HAMILTON, *Actuary.*

Description of Mr. J. D. Woodside's Revolving Harrow and Seed-Cart.

In the construction of my harrow I use a cylinder of about six inches in diameter, made of any solid wood, equal in length to the distance of from face to face of the hubs of the wheels of a cart, to which it is attached. The cylinder moves on gudgeons, passing through the arms of a frame, the four ends of which rest on the end of the iron axle projecting beyond the hubs. This frame is forced back from the cart wheel by a nut on a bolt, which enters the end of the arms of the frame, for the purpose of tightening the chain band, which passes over the band wheel, secured to the spokes on the inner side of the cart wheel, having a V groove to receive the chain. Near each end of the cylinder is a cast iron cylinder, with a V groove of about eight inches diameter, in which the chain plays with a cross, which gives the cylinder a counter motion to that of the cart wheel. The circumference of the band wheel on the spokes of the cart wheel being about 128 inches, and that of the cylinder wheel 24, gives six revolutions of the cylinder to one of the cart wheel; consequently, the teeth on the cylinder (39 in number) move with a rapidity which roots up all kind of weeds, such as crab grass, wire grass, vines, &c., and, at the same time, pulverizes the earth most effectually, to the depth of six inches or more, the length of the teeth. By placing the chain band over the wheels, without the cross, the cylinder will, of course, revolve with the cart wheel; and as it makes six revolutions to one

of the cart wheel, the cylinder, weighing 250 lbs., acting as a roller, tends to mash the clods of earth, which the teeth in revolving cut and lighten up, in a very effectual manner. In working the implement without the cross in the band, it does not require much power, but it is evidently not so effectual in destroying weeds, &c. There is a contrivance for elevating the harrow or cylinder, for passing over stumps, &c., by means of a windlass. The grain is distributed from the cart by a sieve of sheet iron, in the form of two spouts, having a descent each way, from the centre of the cart in front, and passing under the shafts, extending as far out as the cart wheels. To these spouts, or sieves, which are perforated to suit the size of the grain to be sown, is connected a mouth-piece of leather, in the upper end of which is a square frame of iron with a bolt thus, ⊓ which bolt enters the front board of the cart, and suspends the sieve. A hopper, with a leather mouth-piece, placed inside of the cart, conveys the grain to the sieve, which is always full while any grain is to be seen in the hopper. The grain is shaken through the sieves by means of a cog wheel, which strikes the ends, and are revolved by a band which passes over the hubs of the cart wheel, and the two cog wheels on each side of the cart. The faster the cart moves, the faster the grain falls; and the quantity to be sown to the acre, is regulated by the number of holes in the sieves.

The harrow and seeding apparatus can be attached to, and detached from, the cart in five or ten minutes, so that the cart is always at service for other purposes.

Gentlemen of the Committee,—This explanation of my harrow, &c. I hope will prove satisfactory, and enable you to make your report. As the two gentlemen who were present on the 26th instant, when the harrow was in operation, were of opinion that the implement required much power, I must beg leave to remark that I was harrowing ground six inches deep, which had only been ploughed to the depth of four inches, and in addition to which, the shaft horse received but little aid from the leader. I am willing to admit that my mode of harrowing requires more power than the common harrow, and I think my harrow is richly deserving of more power, as it does the work far, very far, superior to the implement heretofore used for that purpose. As regards the common harrow, I consider it a very rough, inefficient affair, which merely scratches two or three inches of the surface of the earth, covering the clods, but not breaking them; this has been fully proved, by passing my harrow over after it. I am fully persuaded that with three horses, and one hand, I can do more work than six of the old-fashioned harrows, and in better style.

I make these remarks, not by way of boasting, but from a conviction that the common harrow cannot, from the nature of its movement, compete with mine.

Very respectfully,

Your ob't. serv't.,

JAMES D. WOODSIDE.

Philadelphia, Sept. 27, 1834.

Report on Mr. John Pierpont's Fireplace.

(WITH A COPPERPLATE.)

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination a Stove, or Grate, denominated the "Doric Fireplace," invented and patented by the Rev. John Pierpont, of Boston, Massachusetts, and assigned by him to Jos. L. Lord, Esq., of Taunton, in that state, REPORT:—

That the stove, or grate, under consideration, claims to furnish, according to the words of the patentee in the specification, "a new and useful method of warming and ventilating rooms, by burning anthracite, or other coal, in an open and portable fireplace, or stove, which I call the DORIC FIREPLACE; which may be made in a variety of different forms, but in every form must be constructed and arranged upon the principle of *supplying to the room that is to be warmed and ventilated, in lieu of the air that, through the smoke flue, or chimney, passes out of it, and that by the operation of the fire itself—an equal quantity of fresh air from without the room, which, as it comes in, is warmed by being made to pass over or between the heated surfaces of bodies not metallic; or, if metallic, bodies that have not been brought into contact with a burning substance.*"

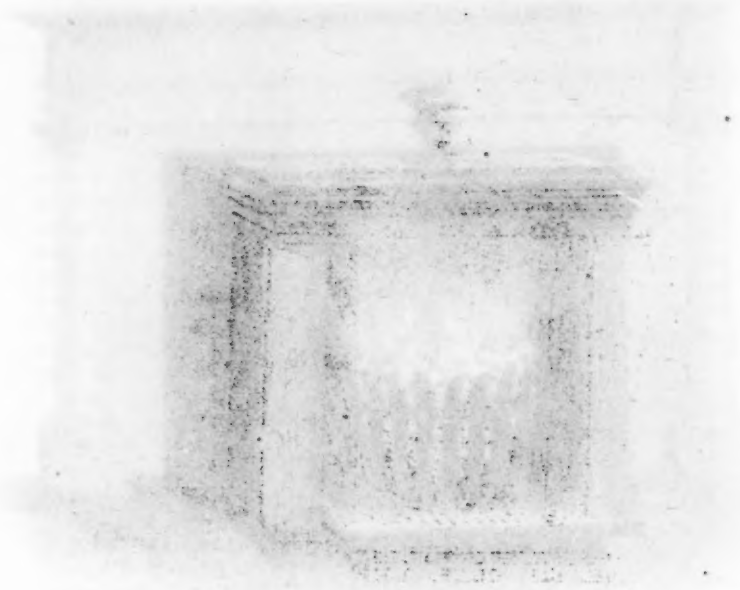
The apparatus is denominated the DORIC FIREPLACE, because the inventor has preferred to construct it with Doric columns, and to give to its other parts a form corresponding with that order of architecture, as represented in the plate herewith presented. It is observed, however, in the specification attached to the patent, which has been placed in the hands of the committee, that "although this simple form is preferred, from a belief that its beauty consists in its severe simplicity, it may yet be varied in this respect; and that the columns, or indeed any other part of it, may be ornamented with brass, polished steel, or other material, according to the taste of the manufacturer, or the purchaser, without departing from the principle upon which the fireplace is constructed."

Fireplaces and stoves have been frequently constructed, in which air from without the apartment to be warmed, is admitted to circulate between plates heated by the fire, and thence to pass into the room, to supply the place of that which passes through the fire, and up the flue; but the committee is not aware that this has been effected, without allowing the air so admitted to come into contact with metallic plates, heated by contact with the fire; the accomplishing of this object is the characteristic feature of the Doric Fireplace.

The stove, with the exception of the lining, is, in preference, constructed entirely of cast-iron; but the fuel, which is contained in an open grate, is not in contact with the metal, excepting with that portion of it which constitutes the grate bars. The back and ends of the chamber of combustion are formed of fire brick, moulded for the purpose. This fire brick is kept, by suitable ledges, from contact with the metallic plates which form the shell of the stove, so that the air

PATENT

DORIC FIREPLACE.



admitted from without may pass up freely between the two, and enter the room through fret-work openings in the top plate, or other convenient apertures. In the specification, very particular directions are given respecting the form, and the mode of uniting, the different parts; but of these it is unnecessary to give a detail in this report, as they may be varied in numerous ways, without affecting the principle upon which the main dependence is placed. A point of the highest importance in putting this stove together, is, to render the junctures perfectly air tight, that there may be no admixture of the gaseous products of combustion, with the heated air by which the room is to be ventilated; the danger of this has, it appears by the testimony of those who have used it, been effectually guarded against, by the skilful manner in which the junctures are made; so that, with ordinary care, a good mason will not fail in the setting it in a proper manner.

Your committee was apprehensive that, from the imperfect conducting power of fire brick, but a small portion of heat would be communicated to the cold air admitted from without; but they are assured by one of its members, who has had a fireplace of this description in use for a considerable period, that soon after lighting the fire, the air flows in through the proper apertures, as highly heated as is either desirable, or safe; whilst it does not, even when the fire is most intense, undergo that deterioration which is always produced by highly heated metallic surfaces.

From an examination of the stove itself, with the addition of the testimony before them, your committee are of opinion that it is well calculated to fulfil the intentions of its inventor—namely, the introduction of a sufficient quantity of air to ventilate the room, which air is first rendered warm by a portion of that heat which, in grates of the ordinary construction, is entirely wasted.

By order of the committee.

WILLIAM HAMILTON, *Actuary.*

November 13th, 1834.

Report on Mr. L. Norcross's Diving Apparatus.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Diving Apparatus, invented by Mr. L. Norcross, of Dixfield, Maine, REPORT:—

That they have examined the apparatus, and have witnessed an experiment made with it, by Mr. Norcross, at the Navy Yard of this city.

The diving apparatus consists of a dress of the cloth coated with gum elastic, so as to be entirely impervious to water; this dress covers the entire person, as high as the neck. A metallic head-piece protects the head, and, resting upon the shoulders, is connected, by a water tight juncture, with the dress. A thick piece of glass, in front of the helmet, enables the wearer to see objects which may be in front of it. Two tubes pass from the helmet upwards, being of flexible material, but of sufficient stiffness in the cross section to retain the

cylindric shape, while exposed to the pressure of the water. One of these tubes communicates with the interior of the helmet, by a pipe opening near the mouth of the diver; this tube is for the supply of fresh air, which is thrown in by a forcing pump, worked by an assistant, who follows, in a boat, the motions of the wearer of the dress. The other tube opens at the top of the helmet, and is for the escape of the air vitiated by respiration. The contrivance for regulating the escape of the air is very simple and ingenious, and, the committee believe, entirely effectual: in the escape tube is a part, just above the helmet, which is flat, or formed of two simple folds of elastic cloth, or of leather; the sides of this portion being pressed together by the water, no air can escape, until the pressure of the air forced into the apparatus is greater than that of the water in which the tube is immersed, when the doubling will open of itself; should the supply of air be inadequate at any instant, this doubling may be closed by the hand of the diver. The whole dress is inflated by this arrangement, and the disagreeable effects of the contact of the cloth, and the pressure of a non-elastic fluid, are prevented. The hands are protected by gloves covered with gum elastic, and forming part of the dress; the hands and arms are thus at perfect liberty for motion. The feet are protected by sandals over the dress, and stability insured by weighting the sandals with lead. The place in which Mr. Norcross made his experiment in this city, was unfavourable to ready motion, the bottom of the river consisting of very soft mud; but he was able to change his place with considerable rapidity. The committee were entirely satisfied with the apparatus, and with his management of it, and believe that it may be used with great advantage in many cases, where examinations are to be made, or operations to be conducted under water.

In regard to the novelty of the invention of Mr. Norcross, the committee are not so fully informed as in relation to its efficacy. Similar devices have been applied in conjunction with, and without, the diving bell; and in one case of a successful experiment in England, that of Mr. Bell, at Yarmouth, the material of the dress, and the general features of the apparatus, were similar to the corresponding parts as used by Mr. Norcross. A similar dress has been patented by Mr. N. Wolcott, of Delaware, and by Messrs. F. Smith and L. S. Steele, of Virginia. The committee do not know the nature of the minute details of the apparatus in either of the cases referred to.

By order of the committee.

Nov. 13*th*, 1834. WILLIAM HAMILTON, *Actuary.*

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JUNE, 1834.

With Remarks and Exemplifications, by the Editor.

1. For *Zinc Cans for Cotton Roving;* William A. Crocker, Taunton, Bristol county, Massachusetts, June 3.

The patentee says, "My invention, or improvement, consists in the substitution of sheet zinc for tin plate, the material heretofore universally employed for that purpose. In all other respects, excepting in the material employed, the cans are similar to those now in use; and the manner of soldering the sheets together, of putting in the bottoms, and of strengthening them with rims, or hoops, is such as is well known to the workers in metals. What I claim, therefore, as my invention, is a *new manufacture* of cotton cans, by making them of sheet zinc, a material not before used for that purpose."

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2. For a *Chain Saw, for sawing timber, &c.;* Phineas P. Quimby, Belfast, Waldo county, Maine, June 3.

This is a saw which stands a fair chance of being unique in its character, as we are of opinion that not more than one of the kind will ever be brought into existence. It is to consist of links put together like the fusee chain of a watch, which links are to have teeth inserted into, welded, or otherwise affixed to them; these teeth are to widen at their points, to enable the saw to clear its way. The links are to form an endless chain, which is to pass over two pulleys, placed one above the other. The carriage that is to sustain the article to be sawed, has in it some novel contrivances, which are particularly described and claimed; as this part, however, is only of secondary consideration, we do not think it necessary to dwell upon it, viewing, as we do, the principal thing in the whole instrument, the saw, as utterly worthless.

Were we to attempt to urge all the objections to this contrivance which present themselves, we should fill a large space to little purpose, as we think that no practical man, who knows what is necessary to a well-operating saw, will need any argument to convince him that, however well this chain saw may be made, it will still be a very shackling affair, operating very indifferently at the best, making a kerf of unnecessary width, be extremely liable to get out of order, costly in its construction, &c. &c.

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3. For a *Cooking Stove;* George J. Prentiss, Smithfield, Providence county, Rhode Island, June 3.

The description of this stove is signally imperfect; we are told, however, that it is "to burn anthracite coal, with a circular revolving oven, made of cast iron, resting on the centre at one end, and on two wheels at the other. It may also be made of sheet iron, and cased with a lining of tile, or fire brick. The exterior part of the oven, when overheated, is turned by means of a crank, so that the heat may be applied, when necessary, to its cooler parts." According to the drawing, the oven is to be placed towards the back of the stove, and is to consist of an exterior case, which is stationary, and an interior, cylindrical, revolving oven, about one-fourth part of the circumference of which is exposed to the action of the fire. There are shelves within it, upon which the articles to be baked are placed, and which are to remain at rest during its revolution; how they are

to be fixed, we are not informed, but could certainly invent a mode of doing it.

There is no claim made, but dependence is manifestly placed upon the revolving oven, which, however good it may be, is, unfortunately for the patentee, not new. In the year 1826, the Franklin Institute offered a premium for a cooking stove, in which anthracite coal should be burnt; and this was awarded to Mr. Joseph R. Page, of Philadelphia, who obtained a patent for his stove, on the 24th of March, 1827. The oven consisted of a rotary cylinder, different sections of which might be exposed to the fire, exactly as in that above described, the articles which were being baked remaining at rest upon the shelves or bars used to sustain them. The patentee was not a stove maker, and not so situated, therefore, as to bring this stove into general use, and its merits were, probably, never fairly tested, excepting by himself.

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4. For a *Machine for Manufacturing Horse Collars;* Ebenezer Whitney, Chenango, Broome county, New York, June 4.

A cast iron mould is made, of the size and form of the inside of a horse collar, and this is to be securely bolted on to a horizontal bench. The collar, after being stuffed, is to be placed upon this mould, and drawn close to it by means of a rope which is passed round it, the rope being tightened by a screw affixed to a vertical post, opposite to the pointed end of the mould. When the collar is thus secured, a few blows of a mallet will, it is said, cause it to take its proper shape.

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5. For a *Triple Elbow, or Rafter, Press;* Robert Bradley, city of Natchez, Mississippi, June 4.

This is a sort of toggle joint press, intended principally for pressing cotton, hay, or other articles, into bales. The follower is to be brought down upon the bed-piece by straightening the toggle joints, which straightening is to be effected by blocks and tackles, drawn tort by passing the end of the rope round a drum, or by other suitable means; but, however operated upon, the patentee "claims the exclusive privilege of working it."

We do not perceive any thing in the arrangement of this press, calculated to ensure a preference to it over many others already in use.

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6. For a *Thrashing Machine:* James D. Emes, Lansingburgh, Rensselaer county, New York, June 4.

The claims set up in this case are to "the cast iron cylinder, with its bevilled beaters, as described, securing the operation of separating the straw in a shifting position, when under the operation of thrashing. Also, the concave commencing with a roller, which may, or may not, be dispensed with; and the slats or bars as described, to continue and finish the concave; and also the feeding motion, so far as the two rol-

lers are concerned, together with the free roller in the pitch board."

We have heard of such a thing as "darkening council with words without knowledge;" and in reading the specification, one might be tempted to believe that it was intended as an illustration of the process in the mind of the writer of the foregoing quotation. The description of this machine is a story of great length, consisting of many well-filled pages, over which we have carefully looked, in the hope that we might discover a discovery; but, alas! all to no purpose. We have, it is true, met with some new terms, the meaning of which we have guessed at by the context; but as to any thing novel in the machine, if it exist, it is too recondite, or transcendental, for us.

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7. For *Mills for Grinding Corn, or other Grain;* Samuel M. Handy, John Albee, and Enoch B. Cutts, Hallowell, Kennebec county, Maine, June 6.

"A cylindrical stone," which *cylinder*, by the by, is the frustrum of a cone, about sixteen inches long, and fourteen inches in diameter at one end, by twelve at the other, is to be enclosed between two other stones, each of which is excavated to receive one-half of it, and to admit the spindle by which it is to be turned. There is also an opening for feeding the grain, and another for the exit of the meal. Of the frame, we need not say any thing; there is nothing particular in its form or substance, all the presumed novelty in the machine consisting in "the peculiar form of the stones," which, with the "particular application of said stones, and their arrangement," constitute the claim. This invention, it appears, is tripartite, each of the inventors having contributed his share of knowledge to bring it to perfection; and as the claim consists of three simple items, we suppose that one of the parties contributed the "form of the stones," another their "application," and the third their "arrangement."

Should this contrivance not very far surpass our anticipations of its utility, we apprehend that neither of the gentlemen concerned will grow rich upon one-third of the profit to be derived from it.

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8. For a *Machine for Adding;* Daniel Kohler, Sunbury, Northumberland county, Pennsylvania, June 6.

In the volume of the "*Machines Approuvées par L'Academie Royale,*" there is a considerable number described for performing operations in arithmetic, and we could point to many others of more recent date. Judging, however, from the universal fate of such machines, we conclude that they have generally led to the road "round Robin Hood's barn," for we have never seen one, excepting in the collections of some learned societies, where they are deposited as articles of curiosity. We are apprehensive, therefore, that the present patentee has expended a portion of thought and money upon his contrivance, for which he will never be rewarded, either in pelf or in fame. The machine operates by means of wheels and pinions, and the sums added are pointed out by indices. We do not think that we

should perform a service acceptable to our readers, by attempting a description of it, more especially as the patentee has neglected to tell in what particulars its novelty consists, having made no claim, and the whole affair being treated as though the Abacus and Babbage's machine, with all the contrivances intermediate in merit and in time, had never existed.

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9. For an improvement in the *Manufacture of Oakum;* Ebenezer Cook, and Selden Usher, Haddam, Middlesex county, Connecticut, June 7.

Oakum, it is remarked, has hitherto been manufactured from old junk, or rigging, or from new rigging, or yarns spun and tarred for that purpose; but the patentees state that they have discovered that the requisite quantity of tar can be incorporated with the fibres of tow, hemp, or flax, without the necessity of previously spinning it. The process consists simply in immersing the materials in a kettle of heated tar, and expressing the superfluous portion in a press of any construction. The patentees broadly "claim as their joint discovery and improvement, the principle that the proper quantity of tar can be incorporated with the material of which oakum is intended to be made, whether hemp, flax, or tow, in its dressed state, without first twisting or spinning the same; whether effected in the mode aforesaid, or in any other manner."

We are not aware that this mode of preparing oakum has been practised, but from the simplicity of the process, and the extensive use of the article, it scarcely seems probable that it has not been essayed. But admitting the process, as described, to be new, the claim appears to us much too broad, as it includes a naked principle, independently of any mode of carrying it into effect, a thing not patentable; the patentees cannot forestall invention, and deprive another of the reward of his talents, who may contrive a better mode of procedure than theirs. Should any one succeed in doing this, will his process make a part of their invention?

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10. For improvements in the *Air Pump;* Timothy Claxton city of Boston, Massachusetts, June 7.

The patentee of this improved air pump is a manufacturer of philosophical apparatus in Boston, and on a visit to that city, about three months since, we had an opportunity of inspecting his establishment, and of examining many of the instruments made by him. It has been his aim to simplify the various articles which he makes, in order to supply the demand from academies and lyceums, at a price within the means of such institutions; and we were both gratified and instructed by the singular skill with which he has accomplished this purpose, without any sacrifice of utility. In several instances, we should have given the preference to the simple instruments of his make, as better calculated for the business of instruction than the more complex and costly ones usually employed, and described in the books. We have learnt from the public papers, that since our visit, the manufactory

of Mr. Claxton, with his tools and apparatus, have been consumed by fire, and although we have no further acquaintance with this gentleman than that which resulted from a casual visit to his workshop, we have sincerely regretted the event, not only on account of the individual, but also as a real loss to science.

The improved air pump for which the patent before us is obtained is single barreled. The pump plate is elevated above the table, upon four pillars, as is frequently done with double barreled pumps; the barrel is placed directly under the centre of the plate, and is, in general, made to work up and down upon the piston, the latter being stationary. The piston rod descends from the centre of the pump plate, and is perforated through its length; the barrel is fitted between two vertical guides, and a lever, working up and down like a pump handle, has its fulcra sustained by two of the pillars; this lever has an opening to allow it to pass on each side of the barrel, to which it is connected by joints; it is made of cast iron, is japanned, and very neat in its appearance. The barrel is closed at bottom, and open at top; as it descends, the air from the receiver passes into it, and as it ascends, it is forced out through a second vertical opening in the piston, each of the openings being furnished with a valve.

There are some minor arrangements described, which we do not think it requisite to notice. The claims are to "The combination of a lever, connecting rods, piston, or barrel, with suitable guides, valves, ground plate, &c., together, so as to constitute a 'single barrel tube air pump,' whose operation is such that the act of exhausting the receiver presses the pump down on the table, or stand, upon which it is placed. A piston to be used with the movable barrel, in which piston there are two passages for the air; one for it to pass into, and the other from, the barrel, and two valves to close the passages alternately. The application of a gauge to operate by the expansion of air, so as to indicate the degree of exhaustion in the receiver, at any period of the operation. A method of fastening an air pump to the table, as above described, &c."

The kind of gauge claimed is not new, and the method of fastening the pump to the table might, we think, as well have been passed without a claim. The whole apparatus, however, accomplishes the intended purpose—namely, it acts well, and is offered at a very moderate price.

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11. For an instrument for *Supplying and Diffusing the Colour used in Block Printing;* James Rennie, Lodi, Bergen county, New Jersey, June 9.

The specification of this patent is drawn up in legal style, which is all very well, excepting, as in the present instance, when that style is so involved and general, as to be unsuited to the description of a mechanical invention. For example, the machine is said to be for the "supplying or steeping with the ink, colouring matter, mordant, or other liquid or fluid desired or required to be stamped, printed or impressed, or for diffusing or distributing the same, over, under, or throughout, the cloth, felt, sponge, or other article, material, or im-

plement, designed or used for communicating such fluid or liquid to a type, form, or block with which it is intended or required or desired to make stamp print or impression which said cloth felt sponge or other article material or implement is in some processes of printing sometimes known by the name of a sieve."

What is called a description of the instrument is then given, which, by the anticipated consent of all our readers, we will omit, and endeavour, as well as the description and drawing will enable us, to give it in our own brief way.

A wooden trough, rather more than twice the size of the block to be used, is made to contain the colouring matter; a second trough of tin, copper, or other metal, occupies one-half of that first named, the centre of its bottom having a hole through it of one-fourth of an inch diameter. The colouring matter is poured into that space in the wooden trough not occupied by the metal one, and flows thence through a hole in a partition dividing the large trough into two parts, so as to pass under the metal, and up through the perforation in its centre. A sheet of sponge, or similar material, is to be placed upon, and to cover the bottom of the metallic trough, and upon this the sieve, used in such printing, may be placed. The height of the liquid poured into the first trough, with the degree of its fluidity, &c., will determine the rapidity with which it will be supplied to the sieve, and this, therefore, is capable of being properly regulated.

There is no distinct claim made, nor any attempt at distinguishing what is new, from that which is old.

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12. For improved *Saddle Bags;* Joseph H. Latouraudais, Flint Hill, Rappahannock county, Virginia, June 14.

These saddle bags are intended principally to contain the bottles, boxes and instruments, used by physicians; two flat leather boxes, with suitable lids, are to be connected together by a strap, which is to pass over the back of the horse. The boxes are to be divided into compartments, by proper partitions, and the claim is to "the cases as above described."

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13. For an improvement on the *Steam Engine;* Sprague Barber, Providence, Rhode Island, June 14.

The intention of this engine must be judged of by the account of its advantages as stated, and the claim made, by the patentee—the whole of the specification, with the exception of these, consisting of references to the drawings.

"The advantages resulting from this improvement are, First, the position of the cut off valves so near the leading valves, admits the steam at each operation, the steam to pass into the cylinder at the same pressure that it is in the boiler, and immediately, upon the opening of the leading valves. Second, as the cut off valves open before the engine comes upon its centres, the steam accumulates upon the leading valves before they are opened, so that as soon as they are opened, the steam passes into the cylinder with a pressure

equal to the pressure of the steam in the boiler, and this upon its first admission into the cylinder. A regulator on an engine would not effect the improvement, as that operates only on the last part of the steam passing into the cylinder. Third, an engine with this improvement will perform the same work with a far less quantity of fuel than an ordinary engine."

"What I claim as my invention, and for which I ask an exclusive benefit, is the compound eccentric on the main shaft, formed by adding another eccentric to the main eccentric in common use, by means of which two different motions can be produced; the form of connexion between the said two eccentrics, as afore described, by which the motion produced by one may be made to precede the motion of the other, as circumstances may require; and the insertion of a cut off valve in each of the valve chests, just before each of the leading valves of the common engine, thereby compounding the motion of the cut off and leading valves, and regulating the quantity of steam that passes into the cylinder."

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14. For an improvement in the *Making of Glass or Sand Paper;* Isaac Fisher, jr., Springfield, Windsor county, Vermont, June 14.

The machinery described is for the purpose of sizing and distributing the glass upon the paper; the main things claimed are the steaming the paper on the unsized side, which prevents its curling; and the manner of distributing the glass upon the sized surface, which is done by laying the paper upon an endless feeding apron, and passing it under a sieve constructed for the purpose, which sieve vibrates in a close box over the paper.

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15. For *Softening Glass Paper*, after the grains have been applied thereto; Isaac Fisher, jr., Springfield, Windsor county, Vermont, June 14.

In the machine by which the softening is to be effected, the paper is made to pass between steel rollers, of which there are five; three of them stand horizontally, and in the same plane, and two others beneath them, with their gudgeons intermediate between the upper rollers. The glass paper is laid upon a cloth, which passes between the upper and the lower rollers, and traverses once backward and forward, which completes the process. The machine is ingeniously contrived, and well represented.

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16. For an improvement in making *Glass or Sand Paper;* Isaac Fisher, jr., Springfield, Windsor county, Vermont, June 14.

The improvement here made consists in taking quartz rock, and grinding and bolting it in any convenient manner, without first calcining it, and using the same as a substitute for pulverized glass, or natural sand, in the manufacture of paper; a better article being thereby

produced, from the greater hardness of the material, and the consequent durability of the angles.

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17. For an improvement in *Making Glass, or Sand, Paper;* Isaac Fisher, Jun., Springfield, Windsor county, Vermont, June 14.

This patent is taken for an apparatus used for sizing the paper after it has received the glass, or sand. A wooden roller, covered with felt, is to revolve over a pan containing heated size, its lower side wadding therein; the superfluous quantity which it thus receives is pressed out by a metallic roller, as the felt rises from it. The paper, placed upon a sizing board, is then passed between another metallic, and the felted roller, the grained side of the paper being placed in contact with the felt.

We have given but a very general description of the several machines for which the foregoing patents have been obtained, more not being required. There are claims made to each of the contrivances, but we do not think the specifications in this part, sufficiently explicit. Respecting the machine last described, it is said that "The said Fisher does not claim the invention of the above pans, or the manner of setting the same, or the separate parts of said machine, but claims the invention of the manner of applying the same to the purpose of making glass, or sand, paper," which, it seems to us, is not claiming the machine in any form; and it has been decided that the mere application of an old machine to a new purpose, will not sustain a patent. There is a strong resemblance between this machine, and those used for sizing in the manufacture of wadding, but still we think them sufficiently distinct from each other, in the arrangement of the parts, to admit of pointing out the alterations by which the former is adapted to the purpose of sizing sand, or glass, paper.

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18. For an improvement in the *Power Loom;* James C. Kempton, Manayunk, Philadelphia county, Pennsylvania, June 14.

In the weaving of stripes in the ordinary power loom, the width of each stripe is governed by the number of the throws of the shuttle, and in case of the breaking or running out of the weft, the shuttle still goes on, and is replaced by another when it has counted its number, rendering the stripe, in such case, narrower than it ought to be. The object of the present invention is to remedy this defect, by causing the change of shuttle to be independent of the number of throws, and governing it by the actual width of the stripe. The arrangement by which this effect is produced, is not given so much in detail as it ought to have been, for want of a more complete drawing; but the general principle is distinctly set forth. On the end of the cloth beam there is what is called a pattern wheel, which revolves with the beam, and has on it cams, which are made to act upon the levers which raise the shuttles; and as these cams operate only by the turning of the pattern wheel, the shuttles cannot be changed until a cer-

tain width of cloth is wound thereon; the same shuttle, therefore, may be thrown any number of times, if empty, as the beam will not move. The claim is, to "the method described of changing the boxes, independent of the number of throws of the shuttle, by means of the stripe actually woven."

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19. For improvements in *Locomotive Engines, Cars, and Carriages*, used upon Rail-roads; Alfred C. Jones, city of Philadelphia, June 14.

The improvements claimed under this patent are three in number. The first consists in the application of what is called a false flanch, to obviate the difficulty resulting from the rapid wear of the tire, where the tread and flanch come in contact with the rail. When this has taken place, the wheel is to be turned in a lathe, to adapt it to the receiving of the false flanch, which is to be riveted on, in a manner shown in the drawings.

The second relates to the apparatus for supplying water from the cistern of the tender, to the boiler. This consists in the substitution of metallic tubes for the hose commonly used, which tubes have ball and socket joints, or others, admitting of a ready motion in all directions. The patentee says, "I do not in this part claim to be the inventor of flexible metallic tubes, such as I have described; but what I do claim is their adaptation to, and employment in, locomotive carriages and tenders, for the purpose of supplying the engines with water."

The third improvement is in the oil cup, or syphon, which is used for oiling the machinery, and consists in the manner of confining the lid thereof by means of a spring, instead of by sliding, or screwing, as is most commonly done. The mode of applying the spring is represented in the drawing, and its application is claimed.

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20. For a *Machine for Drawing in Perspective;* Richard Lyons, New Rumley, Harrison county, Ohio, June 14.

This machine operates by means of a Pentagraph, in a manner well known. The Pentagraph is to be placed vertically, and one end of it is to be used to sight the object, whilst the other, furnished with a pencil, draws it upon paper. For this purpose, there is to be a vertical frame, one portion of which may contain a pane of glass, and the other a pannel to receive the paper. That end of the pentagraph which is used to sight the object, moves on, or near to, the pane of glass, the sight being the head, or end, of a projecting pin. At a suitable distance from this, there is an eye-piece furnished with a small hole, and looking through this, the pin is to be made to pass over the outline of the object to be drawn. The claim is, to "the application of the Pentagraph to produce the drawing on the paper, or other material, below, or beside, the perspective frame."

A machine perfectly similar in principle was patented by I. Todd, A. Day, and W. Bache, on the 15th of June, 1803, excepting that it was intended for taking profiles only it was applicable, however, to

the drawing in perspective, and was repeatedly so applied. In one particular it was very superior to the machine above described, as, instead of the pin, the end of which is to be passed over the lines of the object, a dark point was made upon a piece of glass; the pin had been previously tried, but was rejected, the glass being incomparably better. In taking profiles, the sighting was made through a tube, with which the object was followed by the eye; but when used for drawing in perspective, the tube was removed, and a fixed eye piece employed. The object was traced *above*, and not "below or beside the perspective frame;" this, however, we suppose the patentee will confess is altogether immaterial; and if not, by ascending to a more remote antiquity, we can show a machine in which the copy was made *beside* the frame.

In the eighth volume of the Transactions of the Royal Society, under date of July 21st, 1673—that is, 160 years ago—an instrument exactly the same in principle with the foregoing, is described, under the title of "*Modus novus delineandi per radios parallelos ad aecqualitatem orthogrophicam, gestus, situs, habitusque quoscunque humani corporis, servata symmetria, proportione que partium.*"

Accompanying the description of the machine employed, there are two engravings, one of which represents it as used for drawing outlines, in the manner of Todd, Day & Bache's machine, and the other with a fixed sight for drawing in perspective, the delineation being made "beside the perspective frame."

We do not suppose that the patentee has been a plagiarist, and stolen the idea from our forefathers, or even from our contemporaries; but one thing is manifest—namely, that his new invention is very old, and that, like many hundreds of his compeers, he cannot sustain his claim.

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21. For *Machinery to supersede the use of Steam in Propelling, &c.;* Louis Marchand, city of Baltimore, June 14.

This, we are told, is called a "safety engine," which name it receives, undoubtedly, because it is not liable to explode; and provided the confidence of more than one man is necessary to the explosion of a project, we may unhesitatingly aver that it will not explode even in the metaphorical acceptation of the term. A boat is to be propelled, or certain machinery moved, by the power of "one or more men, according to the size of the handle of the *swipe*," which *swipe* is a piece added to the end of a lever, and said lever is to be worked up and down like a pump handle—the *swipe*, or addendum, in some way, which does not, and never will, appear, most marvellously enabling the power applied to produce an effect at least a hundred fold.

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22. For *Springs for Rail-road Cars;* Ross Winans, Civil Engineer, city of Baltimore, June 14.

(See specification.)

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23. For a *Plough;* Shem Zook, Armagh, Mifflin county, Pennsylvania, June 14.

The description of this plough is by no means elaborate, and what might have proved a difficult task, the specification of its peculiarities, has been thereby avoided. The land side, we are told, is to be pretty much like that of Carrothers', and the mould board is to resemble Spielman & Miller's. "The parts on which no improvement is claimed are a beam and shafts of wood, and of the common kind and common coulter; also, a sole attached to the hind part of the mould board, which can be regulated at pleasure." We suppose that the word *no* means *an*, but so ends the specification.

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24. For a *Method of Grinding and Polishing Marble, and other Stones;* Samuel Risley, city of Philadelphia, administrator of Richard S. Risley, deceased; June 14.

A wheel of cast iron, grind stone grit, or other material, is to turn horizontally, like a lapidary's wheel; but it is to be made sufficiently large to grind such pieces of marble, &c., as may require it; any of the ordinary substances used in grinding are to be applied to the wheel. For polishing, one of wood, covered with cloth, may be employed.

"The improvement claimed consists in the method of grinding, smoothing, and polishing, marble or other stone, as above described, whereby a great saving of time is effected, and a true surface, and superior polish, is given to the marble or stone."

This patent is taken for a "method of grinding," and not for the machine, or apparatus, by which it is effected. A method, according to our view of the subject, is not one of those things included in the patentable subjects enumerated in the patent law. Where an operation, such as grinding or polishing, is performed by means of a machine, if the machine is not new, there is nothing to patent.

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25. For an improvement in the *Forge Hammer Arm;* James Sharp, Spruce Creek, Huntingdon county, Pennsylvania, June 14.

This patent is taken for a *tappit arm,* or lifter, which is to be fixed into a cylinder, to raise the handle of the tilt hammer. This tappit arm is to be in part of cast iron, and in part of wood, and it is claimed "as described," which description is not such as to enable us to perceive what are the advantages anticipated from its use, nor indeed fully to understand its construction.

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26. For an improvement in the *Constructing or Building of Canal Boats;* John M'Causland, Kingston, Ulster county, New York, June 14.

That boat builders may judge of the novelties introduced into the construction of this boat, we will give an abstract of the specification, there being no claim.

The bilge, from stem to stern, is to be of solid, square stuff, the size depending, of course, on that of the boat. The floors are to be

joined to these timbers by dovetails, or mortises. The bilge timbers are to be rebated, to receive the plank on the sides and bottom, which are to be fastened by bolts. The keelson and keel are to intersect in the bilge timbers, fore and aft the boat. Plank, shears, &c. &c., to be used, as necessary.

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27. For an *Elastic Water Dress;* Leonard Norcross, Oxford, Dixfield county, Maine, June 14.

A dress is to be made of India rubber cloth, or any similar material, with a suitable cap for the head, furnished with strong glass to see through. There are to be tubes for the supply and discharge of air, &c. &c. This patent is taken by one not acquainted with what has been heretofore done, or indeed with what can be effected by such means, as there is no novelty in the plan, and the anticipations of what can be accomplished by it are entirely illusive. We are told, for example, that "a man in this dress can descend to a great depth, and remain there for six hours, or more; enter the cabin or hold of vessels which are sunk; walk about upon the bottom; place rock for the abutments of bridges," &c. &c.

Experience, we have heard, has since convinced the patentee that he had "reckoned without his host," and has taught him something of the powers of nature in this business; we are informed, also, that he has been thereby led to make a real improvement in the management of the apparatus.

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28. For an improvement in the *Cotton Gin;* Jacob Perkins, Bridgewater, Plymouth county, Massachusetts, June 14.

This patent is obtained for a mode of adapting a movable seed board to the cotton gin, so that it may be readily adjusted in any required direction, and the claim made is to the particular mode of adjustment.

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29. For a *Guard to prevent Water from beating under doors;* Daniel Bulkeley, Hampton, Windham county, Connecticut, June 14.

The specification of this patent is very brief, informing us, merely, that the door guard consists of a trough, or channel, which is fixed at the lower end of the door, extending across its whole width; which trough may be made of wood or metal, and is to receive the water as it trickles down the door; it is also to be continued across the threshold, so as to carry the water off to the ground.

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30. For a *Machine for Cutting and Cradling Wheat;* Bernard Jackson, Brown county, Ohio, June 14.

The description of this machine is not very clearly written, but the drawing being well executed, its construction may be collected from the two together, although, without the latter, we can give but a general idea of it.

The machine is to run upon four wheels, two of which are coupled

on that end of it to which the horse is attached, and the other two at the hind, or operating, end. These latter wheels are made rough, to take hold of the ground, and have beviled teeth on them to gear into a bevil wheel upon vertical shafts; one of these vertical shafts carries four scythes, standing out at right angles from each other; above these scythes, there are fingers upon the same shaft to collect the grain. On the opposite vertical shaft, there are what are called discharging arms, which are to deposit the grain, as it is cut, behind the left side of the machine. The claim is to this combination of machinery for cutting grain.

However good this apparatus may prove in certain situations, like other mowing machines, it can be used only upon such land, the surface of which is uniform, and clear from stones and stumps.

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31. For a *Machine for Sawing Wood for Fuel;* Harlow Mitchell, Rutland, Jefferson county, New York, June 14.

This machine, as described, is to be attached to a common saw mill, so as to work a cross cutting saw by the ordinary power of the mill, and to use the ordinary carriage for moving the log, so as to bring it crosswise against the saw. The saw, and indeed the whole apparatus, is so made that it may be attached and removed at pleasure. The patentee proposes to use it in all cases where logs are to be cut transversely, into bolts or short blocks, for any purpose, and avers that, in his first experiment with it, he sawed to the amount of twenty-four cords of wood, from large logs, in twelve hours. The saw which he uses is to be fixed in a rectangular frame, working upon pins, forming joints at each of the corners. One of the vertical timbers of this frame is attached to the frame of the saw gate, there being another parallel to it, from ten to fifteen feet in front of it. The saw is to be hung to two of the horizontal pieces of timber that connect these vertical pieces, one of which will vibrate above, and the other below, the log to be sawed. The saw, like the ends of the frame, must work upon joint pins, and may be three or four feet in advance of the ordinary mill saw. There is a jack, or clamp, the construction of which is shown in the drawing, to hold the log to be cross-cut; this jack is attached to the ordinary carriage, so that, when the water is let on, the log will be carried against the saw. There are several particulars in the action of this machine, which should have been more fully set forth in the specification; and this certainly might have been done, as the inventor professes to have carried the plan into practical operation.

The patentee "claims as his own invention, the application of water, steam, or horse power, to sawing wood transversely; the particular manner of placing a lateral and transverse carriage, with all such variations in the mode of securing them to each other, as the peculiar formation of the mill may require; the peculiar manner of securing the log between the standing and movable posts, but brought together by a jack; with all such modes of securing and making the joints, as the peculiar situation of the place, and presence of materials, may make most convenient."

We think this claim is too broad, especially in the first member of it, as wood has been frequently sawed transversely by water, steam, or horse power; and if this had not been done, the mere doing so will not justify a claim to all the methods of accomplishing it which may hereafter be invented.

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32. For the *Frame-work of Mills;* William S. Parham, Sussex county, Virginia, June 14.

The specification of this patent consists of a number of particular directions respecting the manner of forming and keying the joints, in framing the upper story of a mill; and also the manner of placing the braces, and flooring joists, and of supporting the latter from the roof above them. We are unable, however, to deduce therefrom any thing new in principle, or superior in practice, to what is already known. The patentee says, "My claim is to the manner in which the frame work of the upper story is put together and secured, as above described, and particularly the manner in which the king-posts support the joists at the lower end of said posts; also the manner of securing the girders to the joists; and to the suspension posts as depending from the joists above, in order to support the weight of the gearing working from the power wheels."

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33. For *Metal Combs;* Allen Porter, Hartford, Hartford county, Connecticut, June 14.

The back of the comb is to be made of a rod, or bar, of any kind of metal, which is to be drilled, so as to receive the teeth; when these have been inserted, the bar is to be compressed, so as to keep them firmly in their places; or, the holes being sufficiently small, the teeth are to be driven in so as to be firmly fixed.

"The improvement claimed is in the fastening the teeth, without soldering or riveting, by putting them into the back, so as to have the back smooth, without having the teeth come through the back of the comb."

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34. For an improvement in *Windlasses for Vessels;* Leonidas V. Badger, and Richard Walker, Portsmouth, Rockingham county, New Hampshire, June 17.

The improvement consists in the application of double palls to a ratchet wheel, or a ship's windlass. A horizontal lever is hung on its centre, above the windlass, and two palls, one from each side of the centre pin, fall into the teeth on the same side of a ratchet wheel, fixed upon the windlass; and, consequently, whichever end of the lever is depressed, the ratchet wheel will be forced round. The claim is to "the application of the above form and power to ship's windlasses, for raising anchors, &c."

We do not know that a ratchet wheel and palls, exactly in the form specified, have been applied to the windlasses of ships; but there is nothing new in the arrangement of the lever, palls, and ratchet

wheel, the same being a well known application to machinery of various kinds.

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35. For a *Machine for cutting Hay and Straw;* Barnabus Davee, Leeds, Kennebec county, Maine, June 17.

There are to be two feeding rollers, one placed above the other, the lower of which rollers is to be turned by a crank, and the upper one borne down upon it by springs. A cog wheel of twenty-four inches diameter is to be placed in the axis of the lower roller, and this to drive a pinion of five inches in diameter, in front of it. The shaft on which this pinion is fixed lies parallel to, and in front of, the rollers, and carries the knife by which the cutting is to be effected, this knife being attached by its ends to arms, standing out at right angles from each end of the shaft; the arms must be of sufficient length to cause the blade to reach the point where the straw, &c. is delivered from the rollers. We suppose that there must be a bar, or rest, of iron, for the knife to cut against, but of this nothing is said. The knife, it is observed, may, if desired, be placed obliquely; but there is not any thing said in the nature of a claim.

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36. For improvements in the *Power Loom;* Aden Holbrook, and Benjamin F. French, Dunstable, Hillsborough county, New Hampshire, June 17.

The specification of this patent refers throughout to the accompanying drawings, which are very perfect, and are necessary to a complete understanding of the things claimed. The improvements made are three in number; the first "is a stop motion, by means of which the loom is stopped of itself, whenever the filling, from any cause, is not thrown into the warp." "Whenever the threads of the warp adhere closely together back of the lese rods, the rods are drawn out of their place towards the harness, by which means defects are produced in the cloth, called draws. In order to give notice to the weaver before any injury arises from this cause, another stop motion has been invented by us, which is the second improvement upon the said loom claimed by us as our invention." "A let off motion, whereby equal quantities of warp, whenever cloth is made, are unrolled from the yarn beam in equal periods of time, is the third improvement upon the said loom which is claimed by us as our invention. By means of it, cloth of an uniform thickness can be made; it is described as follows," &c.

We have thus indicated, in the words of the patentees, the object of their improvements, which is all that we can now do.

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37. For a *Churn;* John Broom, Hallowell, Kennebec county, Maine, June 18.

A band wheel turned by a handle, is to give motion to a whirl on a crank shaft, the crank serving to move the dasher of a common churn, which is fixed immediately below it. This constitutes the whole of the *new and useful* invention before us, to which, however, is

appended a claim to "the particular form and arrangement of the machinery by which the dasher is moved, and the application of the several parts of the machinery to effect the purpose specified."

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38. For a *Water Wheel;* Henry Averill, Richland, Oswego county, New York, June 18.

This is an undershot wheel, to be used in streams where there is but little head and fall. Particular admeasurements are given in the specification, but these we need not notice. The buckets, or floats, are hinged upon the arms, or rims, of the wheel, the hinge being at the lower edge of the bucket as it enters the water; the buckets, therefore, stand in the usual position, bearing against the radiating arms whilst they are entering, and are subjected to the force of, the water; but as they begin to rise from it, their hinges admit of their taking a direction which will enable them to leave without lifting it, hanging off from the arms until carried up to the top of the wheel, when, by their own gravity, they fall against them, and are so sustained until they again leave the water. The patentee avers that, after the experience of a year in the use of such a wheel, he is convinced that much power is gained, which, in the ordinary construction, is wasted by the lifting of the bucket, particularly where there is back water. There is no claim made, but the particular object of the invention is sufficiently distinct, and it differs essentially from the hinged buckets which have been so frequently essayed in running streams; we think also that it offers some advantage from the cause stated by the patentee, whilst there is little, or no, objection to the hinges on the score of complexity.

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39. For a *Thrashing Machine;* John Melvin, Readfield, Kennebec county, Maine, June 18.

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40. For an improvement in the *Machine for Spinning Wool;* Asa Campbell, Kingston, Luzerne county, Pennsylvania, June 19.

This is a very complicated affair, produced by the addition of a number of whirls and bands, and other appendages, to the common wheel for spinning wool; the whole object of which additions appears to be the enabling of the spinster to keep her seat, instead of running out and in with the yarn. The wheel is constructed and turned as usual, but the spindle is attached to the end of a pendulum, which is to be thrown out by placing the foot upon a treadle, and to be drawn back by a weight when the foot is removed. The claim is, to "the principle of throwing the spindle out with the foot upon the treadle, by means of the spindle being attached to a pendulum, to which is connected the different cords, and weight, calculated to bring the spindle back to the person using the machine, thereby making it conveniently worked by the person in a sitting posture."

To accomplish this object, it appears that forty or fifty feet of band

are to be employed, running over the wheel, and five whirls, or pulleys. The old fashioned wheel, for spinning one thread at a time, has nearly received its death-blow from the improvements in machinery; and were a law to be passed, compelling the substitution for it of the above patented improvement, we really think that such a law would effectually give it the *coup de grace.*

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41. For a *Pneumatic Breast Pump;* James P. Stabler, Sandy Spring, Montgomery county, Maryland, June 19.

A glass vessel, having two openings into it, is, in order to its producing the intended effect, to be exhausted of its air by the action of the mouth. One of the openings is to be applied to the breast in the usual manner, and the other is to have a cap cemented on to it, to receive the end of a flexible tube, the outer end of which is to be applied to the mouth. A valve is contained within the juncture of the flexible tube with the cap of the glass vessel, which valve, of course, opens upwards; the construction of it is particularly explained, but is spoken of as susceptible of variations. Through the cap there is a small opening, which is to be covered by the finger whilst the instrument is in use, the withdrawal of the finger allowing it to be removed readily from the breast.

"The improvements claimed are, the application of a valve to the pneumatic breast pump, in which the vacuum is formed by the mouth of the operator; and the perforation of the cap, or vessel, by which means the external air may be admitted to diminish the drawing power of the instrument, when painful to the patient, and by which the operation may be immediately suspended, without inconvenience."

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42. For a *Cooking Stove;* Philo P. Stewart, Elyria, Lorain county, Ohio, June 19.

There is not any thing very peculiar in the construction of this stove, the claim being made to certain modes of arrangement, some of which may have their particular advantages. Those who can appreciate the luxury of a hot dinner, upon warmed plates, will approve of a "warming arch" constructed under the oven, whether the same be new or old.

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43. For a mode of *Increasing the adhesion of the Driving Wheels in the Locomotive Steam Engine;* Ezra L. Miller, city of Charleston, South Carolina, June 19.

(See specification.)

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44. For an improvement in the *Manufacture of Vinegar;* Edward Clark, Saugerties, Ulster county, New York, June 19.

(See specification.)

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45. For a *Self-acting Clock Alarm;* Otis N. Angell, Johnston, Providence county, Rhode Island, June 20.

A good general idea of the manner of setting this alarm in motion, will be obtained by the following short quotation from the specification.

"This machine, so constructed, is affixed to the inside of a common clock case, just below where the striking weight is found by experiment to come at a given hour. The weight on the barrel is then wound up in the same manner that the ordinary weights of a common clock are. When the hour has arrived at which it is wished that an alarm should be given, the striking weight of the clock, in the striking of the hour, descends, and brings up against the perpendicular slide, and forces that down, together with the end of the lever in which it is placed. The other end of the lever is, of course, raised up above the teeth of the ratchet wheel into which it plays. By an additional lever, to be acted upon by the running weight of the clock, an alarm may be sounded at any intermediate time between the hours."

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46. For a *Reaping Machine;* Cyrus H. M'Cormick, Rockbridge county, Virginia, June 21.

The main operating part of this machine is old, as will be seen on referring to our remarks on the patents of T. Manning, vol. viii., p. 195, and of O. Hussey, vol. xiv., p. 37, and indeed there are other points in it liable to the same objection; but when the major proposition is proved, the minor one may be left untouched. The following is a part of the claim:

"My claim is to the arrangement of the several parts so as to constitute the above described machine. And I particularly claim the cutting by means of a vibrating blade, operated by a crank, having the edge either smooth, or with teeth, either with stationary wires, or pieces, above and below, and projecting before it, for the purpose of staying or supporting the grain whilst cutting; or the using a double crank, and another blade or vibratory bar, as before described, having projections before the blade, or cutter, on the upper side; both working in contrary directions, thereby lessening the friction, and liability to wear, by dividing the motion necessary to one, between the two."

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47. For an improvement in *Steam Boilers;* Benjamin Phillips, city of Philadelphia, June 21.

This improvement is said to consist in "a mode of determining or defining the water line, or height of water, in steam boilers." The method proposed is to connect a vertical tube to one end of the boiler, by means of two lateral tubes, one opening into the water, and the other into the steam chamber, in the manner of the glass gauges sometimes used for that purpose, especially in France. The lateral tubes are to be furnished with valves, and the vertical tube is to have a cap, which may be removed at pleasure. To use this appendage, the cap is to be closed, and the two valves in the lateral tubes are to be first opened, and then closed, which will allow the water in them to stand on a level with that in the boiler. The cap on the

vertical tube is then to be removed, in order to gauge the height of the water within it.

We do not believe that when the water is agitated by the motion of a vessel, and by the supply of steam to the engine, that accurate results can be thus obtained, although they might when every thing is at rest. But even admitting that the instrument would act correctly, it would never come into use for ordinary observations. Something is required for this purpose, the indications from which would be forced upon the engineer, or, at all events, which he could observe with scarcely any trouble, or the thing will be neglected.

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48. For a *Washing Machine;* Jotham Chase, Waterboro', York county, Maine, June 23.

There is to be a rectangular box, three feet long, eighteen inches wide, and fourteen deep, the inside of which is to be lined entirely with fluted boards, and there are to be doors on one side to admit the clothes to be washed. The box is be suspended on gudgeons, like a revolving churn, and upon one of the gudgeons there is to be a cog wheel, whilst another wheel, one-half its size, and fixed upon the frame, mashes into it. On turning this smaller wheel by means of a handle, the box will revolve, and the clothes falling from end to end of it, will, it is said, be washed clean in a very short space of time. If so, however, there are other washing machines, already in use, which are so much like it, that we see no reason why they should not operate at least equally well.

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49. For machinery for *Napping and Steaming Woollen and other Goods;* Stephen R. Parkhurst, Providence, Bristol county, Rhode Island, June 24.

This machine has cylinders, so arranged in and above a copper kettle, containing water heated by a furnace, that on turning the respective cylinders by proper gearing, the cloth, attached to aprons on two of the cylinders, may be passed backward and forward, in a state of tension, through the heated water, one roller within the kettle, depressing it for that purpose, whilst napping cylinders, furnished with teazles, or cards, operate upon the cloth.

There are several things claimed, of which the following is an abstract. The tightening of the cloth, so as to preserve a uniform strain, by the arrangement of the cylinders. The arrangement for passing the cloth into the heated water, and presenting it to the napping rollers, thereby securing all the advantages of the steaming process. The rendering the cloth, by this process, glossy, and free from wrinkles. The method of drawing the nappers either on or off the cloth, and the rack and pinions for raising the small frame out of the kettle.

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50. For a *Horse Power;* William Burk, Whitemarsh, Montgomery county, Pennsylvania, June 25.

This horse power is the common movable floor, revolving round

two drums, with so little variation from those in common use, that we do not know, and the patentee does not tell us, in what the invention consists. We are informed, however, that it will be a very good thing with which to propel canal boats, and the patentee says, "As I am the original inventor of the application of this horse power to the use of propelling canal or other boats, (which will be of great importance to the public generally,) I claim the privilege of having that part of the application secured to me in the letters patent, with the privilege of regulating the gearing."

We have yet to learn what is intended by the invention of an application of a machine. If a man invents a wheelbarrow, for the purpose of wheeling potatoes about, it does not seem quite reasonable that another shall sustain a patent for the application of it to the wheeling of apples; yet from the tenor of a number of specifications, it would appear that there are many who think this may be done. Whether the application of this horse power has been made to the propelling of canal boats, is a question which we cannot determine; but to "other boats," as, for example, to ferry boats, it has been frequently so applied. We mention this as a mere fact, and not because it affects the validity of the claim above noticed.

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51. For *Lever Valves for exhausting Air and Water;* Hiram Strait, East Nassau, Rensselaer county, New York, June 25.

We are informed that the improvement here patented consists in the "application and operation of valves, on the principle of a balance, for the purpose of percussing, compressing, and exhausting, air and water;" and this information is followed by an intended exemplification of the different modes in which this principle of a balance valve is to be applied. The whole affair, however, is a "fancy's sketch," which never will, because it never can, be brought into practical operation, so as to produce any useful effect, in either of its forms. The principle alluded to is the placing a rod or shaft so as to turn, or rather vibrate, on gudgeons, and attaching to it two somethings, that the patentee calls valves, which are opposite to, and balance, each other. In the plan first described, which is to operate upon air, the valves on each side of the rod are to consist of narrow, parallel curtains, standing somewhat in the manner of the slats of blinds, which are alternately to open and close by vibrating the apparatus; and this is to be applied "to the theory and practice of aerial, marine, and submarine navigation: to the propulsion of cars on railroads, boats, windmills, and ventilation;" how, we do not learn, and never shall. With this item of the information communicated, we dismiss the subject, lest we should not do it adequate justice.

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52. For improved *Medicated Liquid Magnesia;* Richard Jordan, and Matthew Anderson, city of Philadelphia, June 25.

Mr. John Cullen, then of the city of Philadelphia, obtained a patent about sixteen years since, for liquid magnesia, which was formed by rendering magnesia soluble by its combination with carbonic acid,

in the ordinary mineral water apparatus. To make the beverage palatable, sugar and rose water were put into the fountain with the magnesia. The mixture, as employed by the present patentees, consists of 12 gallons of water, 2 lbs. carbonate of magnesia, 8 lbs. loaf sugar, half a pound of Rochelle, or other purgative salts, 12 grains sulphate of quinine, 4 ounces iron wire, 1 lb. compound aromatic tincture. The quinine is to be dissolved in the aromatic tincture, and the whole put into a fountain, and carbonic acid forced in until the magnesia is dissolved. The patentees say that these alterations are made with a view to the rendering of the compound more purgative, and at the same time giving to it a tonic property. As the process for dissolving magnesia is not new, they are of course limited to the kind of mixture which they have designated.

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53. For an improvement in *Inclined Planes for Rail-Roads;* Levi Burnell, Elyria, Lorain county, Ohio, June 26.

"This improvement, for enabling locomotive engines to ascend inclined planes, with their full complement of wagons, without the intervention of stationary engines and their appendages, consists simply, 1st. In the use of an additional rail or rails placed parallel, and near to, but more elevated than, the track of the way to which the improvement is applied. 2d. In the application of a wheel, or wheels, with peripheries of smaller diameter, in connexion with each of the ordinary working or bearing wheels of the locomotive carriage."

Those who are acquainted with the proposed improvements on rail-roads, will perceive that the plan before us is but a new edition, without additions, of what has been before done. The often proposed formation of teeth upon the rail, and smaller wheels, to prevent slipping are also alluded to by the present patentee. In vol. 8 of this Journal, page 22, there will be found a specification of a patent "For locomotive carriages, and rail-roads adapted thereto," obtained by Emmor Kimber, in which all the above proposed improvements, with some others, are included. For some of them, we might go still further back.

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54. For an improved *Saw Mill;* Asa Ransom, jr., Clarance, Erie county, New York, June 26.

A mill saw is to be hung in the ordinary way, but it is to have teeth on both its edges. The head blocks are to be so constructed as to admit the board to be sawed entirely off, leaving no stubshot. There must be two feed hands, and two rag wheels, to move the carriage in either direction. The specification is very brief, and does not describe the respective parts with any clearness, while the drawing is altogether inadequate to supply the deficiency. This, however, is of the less importance, as in a patent obtained by Mr. Joseph Newton, of Monroe county, New York, on the 1st of October, 1830, an account of which is given at p. 10, vol. vii., it will be seen that "the improvement proposed is to have teeth on both edges of the saw, and to construct the mill in such a manner that the log may be sawed in

passing either way. There are to be two feed hands, and two rag wheels, operating in reversed directions."

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55. For a *Machine for Spreading Hay, &c.;* Joab Centre, city of Hudson, Columbia county, New York, June 27.

A frame, fixed upon wheels, is to be drawn by a horse; a shaft crossing this frame, and revolving upon gudgeons, is to have rods, or long teeth, projecting from it, so as to reach within an inch or two of the ground. A band from one of the wheels passes round a whirl upon the shaft, causing it to revolve rapidly as it is drawn along, and consequently to scatter the mowed grass which is to be made into hay.

There is no claim made.

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56. For improvements in the *Machinery for Manufacturing Wood Screws;* Rufus C. and Clement O. Reed, Worcester, Worcester county, Massachusetts, June 28.

After describing this machine, by the aid of several drawings, representing its construction in detail, the patentees say, "Most of the operative parts of the machine, as within described, are such as are well known, and are used in other machines, but differently combined together; we do not therefore claim them, in their individual characters, as making any part of our invention; but what we do claim, is the placing the main shaft, which carries the screw, vertically, and giving to it a continuous motion, by the general arrangement of the parts described. We also claim the mode of feeding herein set forth, as adapted to the motion of the vertical shaft, and we do hereby declare that whilst we claim the general principle, or mode of action, of the vertical shaft and its appendages, we do not intend to confine ourselves to the exact mode of construction herein set forth, but to vary the same in any manner which we may deem proper, whilst the principle of action remains the same, and similar effects are produced."

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a Patent for a mode of increasing the adhesion of the driving wheels of the Locomotive Steam Engine. Granted to EZRA L. MILLER, *Charleston, South Carolina, June 19th,* 1834.

To all to whom these presents shall come, be it known, that I, Ezra L. Miller, of the city and district of Charleston, state of South Carolina, have invented a new and useful mode of increasing the adhesion of the driving wheels of the locomotive steam engine on railroads, by using the tender, or car, next the engine, for the purpose of adding weight to the driving wheels of the engine, at such times only as a greater adhesion is required than the weight would give, which it would be practicable to carry as a fixed weight on those wheels, without injury to the road.

At the points of starting, and on the ascents where increased adhesion is required, I attach part of the weight of the car, or tender, which is next the engine, to the end of the frame of the engine next the driving wheels, which may be done by means of a lever, screw, wedge, or pulley, and detach it again, when the increased adhesion is no longer necessary.

The mode which I have used, and found to answer perfectly in practice, is simply to connect the car, or tender, next the engine, to the engine, by a strong iron bar, or lever, one end of which is bolted to the under side of a cross timber in the frame of the car, or tender, a little back of the centre, and which lever extends under the frame of the tender, to the end of the frame of the engine, and into the iron which, together with the drawing bolt, secures it to the engine.

Transversely to this lever, I attach to the end of the tender next the engine, two levers, so that their fulcra shall be six or eight inches on each side of the main lever, or drawing bar.

These levers have a jaw, or pivot, five or six inches in length, directly over the main lever, and should be about $4\frac{1}{2}$ feet in length.

When the increased adhesion is wanted, the engineer has only to place his foot upon the ends of these levers, and press them into a hook, or groove, for that purpose, on the corner post of the tender; and a portion of the weight of the car, or tender, next the engine, is thus thrown upon the driving wheels of the tender; and when the increased adhesion is no longer wanted, this weight is detached by simply loosening the ends of the levers.

What I claim as my invention, is the making use of the car, or tender, next the engine, for the purpose of increasing the adhesion of the driving wheels of the locomotive steam engine, at those points where more adhesion is required than the weight would give, which it is eligible to carry as a fixed weight on those wheels, whether the same be effected in the mode above described, or any other which attains the same end.

E. L. MILLER.

Specification of a Patent for an improvement in the mode of manufacturing Vinegar. Granted to EDWARD CLARK, *Saugerties, Ulster county, New York, June 19th,* 1834.

To all to whom these presents shall come, be it known, that I, Edward Clark, of Saugerties, Ulster county, state of New York, have invented or discovered a new and useful improvement in the manufacture of vinegar, and that the following is an exact description of the same.

I prepare suitable vessels, casks, or cisterns, of a capacity to correspond with the quantity of liquor on which I wish to operate, and arrange them internally in a manner very similar to the casks made by M. Laucks, modified by M. Tier, for the manufacture of vinegar —an account of which may be found in many of our scientific periodical works. I then connect the upper part of these vessels, casks,

or cisterns, by means of pipes, to an air-pump, or any kind of blowing apparatus, in such manner as that, when the air-pump is put in operation, it shall draw a current of air through the vessels aforesaid, and deliver it through a refrigeratory apparatus for the purpose of condensing such portion of the liquor as the air may hold in solution, and thus preventing its loss.

Instead of this arrangement, I sometimes force a current of atmospheric air into these vessels, casks, or cisterns, near their bottoms, by means of an air-pump, or other blowing apparatus, from whence it passes to their top, in apparent contact with the liquor, and is from thence led off, by means of pipes, through a refrigeratory apparatus, in the same manner, and for the same purpose, as above set forth and described.

What I claim as my invention or discovery, and for which I ask letters patent, is the application of the blowing apparatus to these vessels, so as to induce, or create, a more rapid current of atmospheric air, through liquids being converted into vinegar, than would otherwise take place.

EDWARD CLARK.

TRANSLATIONS FROM FOREIGN JOURNALS.*

Methods of Tanning Skins and Hides, by using Liquor of Tar, and of Soot.

In compliance with requests which have been made to us, we offer to our readers two processes for tanning, by means of the liquors of tar, and of soot, varying a little in their form; the ingenious workman will be able to avail himself of whatever may be useful in the two methods.

PROCESS OF WILLAIREBERRES.

Preparation of the Tar Liquor.

Throw about eighteen or twenty pounds of good tar, into 100 gallons of boiling water, add a sufficiency of lime to form a thick paste, then pour cold water upon this composition, that the lime may be converted into powder; add again about a bucket of tar, and an equal quantity of powdered lime, and stir the whole well till you obtain once more a thick paste.

The whole composition is distributed into several vessels, or vats; boiling water is then poured into the vats, taking care to stir the composition with a shovel, three or four times, whilst pouring it in. As soon as the water is mixed in the vats, these vessels are covered, and, twenty hours afterwards, the liquor may be used.

Preparation of the Liquor from Soot.

Put into a boiler, for every hundred pounds of soot, sixty gallons of boiling water, and four pounds of lime in powder, taking care to

* Translated by request of the Committee on Publications.

stir the whole three or four times with a shovel, while filling the boiler; then cover the boiler, and, at the end of twenty-four hours, you may make use of the liquor it contains, after having filtered it in a bucking tub pierced with small holes, and filled with fine sand; the clearer this liquor is, the better.

Preparation of Skins intended for prepared, or glossy, Leather.

The skins thus prepared are put into cold vats of gallic acid, and boiled bark of oak, in which they remain four or five days, and even a week; after which, they are taken out, and steeped in the vats three or four times daily; they are then put in warm liquor of tar, diluted with an equal quantity of water, and the strength of this liquor is gradually augmented till it reaches its first state. The skins, after remaining fifteen days in the liquor, are put again in the vats of gallic acid, and boiled bark of oak, as at first—then in weak tar liquor; they are then withdrawn, and steeped in the vats three or four times daily, during the first fortnight; they are then shifted into bucking tubs, containing liquor of its full strength; they are taken out, and again steeped two or three times daily, until they are well soaked in the liquor.

The skins, having reached this state, are put into a vat of warm water during half an hour; they are afterwards taken up, and placed upon a table of marble, resembling those used by curriers to thin their skins, upon which they are brushed, washed, and cleaned, on the flesh and grain sides, three or four times a day, during the last week that the skins remain in the liquor. This operation being ended, the skins are put, during a week or more, according to their thickness, and the use they are intended for, into a vat of warm liquor of bark, or sumac liquor, and, when taken out of this vat, they are dried in the usual manner.

Preparation of Hides for Sole Leather.

Hides intended to make sole leather, must, like the preceding, be haired, fleshed, and worked, as usual, upon the marble table; they are then put, for several days, into a cold vat of gallic acid, and of boiled oak bark; after this preparation, they are taken out and steeped in the manner indicated for glossy leather, and they are put into bucking tubs, containing a weak, warm, soot liquor, about one-third or one-half as strong as at first. The skins are alternately taken out and put into this weak liquor, three or four times, daily, for more than a fortnight; they are afterwards taken to a bucking tub, containing warm liquor in full strength, taking care to steep them in this liquor three or four times a day, until they are thoroughly impregnated; they are then dried, and steeped about half an hour in a vat containing warm water; after this, they are placed upon a marble table, on which they are cleaned, washed, and brushed, three or four times, both upon the grain and flesh sides. The skins being thus prepared, a strong and warm liquor of oak bark is made, and in this they are steeped three or four times, daily, until the opera-

tion is completed. Care must be taken to dry the skins every time they are steeped in this last named liquor.

Process of Tanning Hides with Soot and Tar Waters.

By Thomas Ashmore.

1st. In the process, may be used every kind of soot, produced either by the combustion of bones, and other animal matter—or by that of wood, turf, or other vegetable substance—or by the combustion of tar, pit-coal, and other bituminous products:

2d. Of oils, and other empyreumatic liquids, produced by the distillation of various animal, vegetable, and bituminous matters:

3d. Of every kind of empyreumatic gas, produced by the combustion, or the distillation, of vegetable, animal, or bituminous substances:

4th. Of every liquor with which the gases above mentioned have been washed, or with which they have been in contact.

Preparation of Soot and Tar Waters.

Soot Water.—The soot from the upper part of the chimney only should be made use of, as it is of better quality, and very preferable to that which is formed in the lower part.

With one hundred pounds of soot, are mixed three pounds of quick lime; this mixture is put into a large tub, provided with a stop-cock, and having a double bottom; the soot and lime are mixed with a little cold water; then boiling water is poured on, until the two waters amount to about forty-eight gallons; the whole is left to settle twenty-four hours; after which, as much of this liquor as can be obtained, is drawn from below into a vat, or other vessel. The soot is again mixed with a fresh portion of quick-lime and warm water, in which four pounds of sal-ammoniac are dissolved. This liquor, after remaining twenty-four hours, is drawn off as before, and the same process is continued as long as the soot will yield a liquor whose value will cover the expense.

The liquors thus successively obtained, as above, may be mixed together, or the weakest may be used in place of pure water, with fresh quantities of soot and quick-lime, according to the strength wished for in the liquor; and even the first liquor, which is the strongest, may be rendered, if desirable, still stronger.

Tar Water.—To every ten pounds of quick lime, the same weight of water is added, to reduce it to powder; twenty-four pounds of vegetable tar is also added; the whole is then worked, so as to form a complete mixture. Then pour on about 120 gallons of boiling water, in which have been previously mixed, or melted, twenty-four pounds of sal-ammoniac. This mixture, stirred several times, and after remaining twenty-four hours, is separated from the settlings, and furnishes the tar water, which may be used.

Observations on the two preceding Liquids.

Tar water and soot water may be made by the simple infusion of tar or soot in warm water, and these liquors will convert skins

into leather, but they will be too weak for many uses. A stronger liquor may be obtained by making use of quick-lime and water, but the strongest liquor is that which is made with quick-lime and sal-ammoniac.

Preparation of Leather with these Liquors.

To prepare leather with these liquors, the hair is taken from the skins, and they are worked in the usual manner; then, instead of putting the skins into vats, as the tanners do, they are placed in a large tub, in which they are covered with soot or tar water, which has been rendered clear by filtering through sand, or some other filter; the skins are left, during twenty-four hours, in the liquor; they are then transferred to a tub of quick-lime and water, for twelve hours; after this, they are again put into the tar or soot water; and they are changed from one tub to the other, until they have acquired, internally, a deep brown colour.

The time necessary for this operation depends on the thickness of the skins, the strength of the liquor, the temperature, and other variable causes.

The skins, after having undergone this preparation, are taken out of the liquor, and exposed to a current of air, to dry them; they are then replaced in the soot or tar water, in which they remain forty-eight hours, at most; and coming out of this water, they are immediately put, during an hour or two, into the water of quick-lime, and removed alternately from the liquor to the lime-water, until they are completely converted into leather; finally, they are finished in the usual manner. [*Journ. des Connais. Us. et Prat.*

Method of Making Soap from certain Animal Substances.

In manufactures, the refuse matter should be turned to account as far as possible. We propose, in the present article, to give directions for making a soap with the refuse matter of wool, cloth, &c.

It is well known that, when wool is combed and prepared for spinning, small parts of it escape, and that in fulling and shearing cloth, also, small parts are separated. These scraps should be collected, to extract from them a soapy substance, which, notwithstanding its softness and fluidity, is very fit for fulling and whitening. The following is the method of preparing it.

Begin by making a strong ley of wood ashes, and add to it one-tenth of lime; pour on it warm water, until an egg will swim on the water, above the ashes; leave this mixture to settle for twenty-four hours, or more, if requisite, keeping the ley at the temperature of about 60° Fah. Pass this ley through a kind of sieve, made of tin plates, with a layer of straw, to prevent the ashes from passing with the ley. Pour this ley, when boiling, upon the particles of wool, at the same time stirring and boiling it carefully; and place this new mixture on the fire, to be there boiled a second time. The soapy substance begins very

soon to thicken. Throw in particles of wool, until the ley is saturated with them, and ceases to take a grayish green colour.

The coarse parts of the shearing of cloths, and the hair of all kinds of animals, are not so readily converted into a soap as the pickings of the combing and spinning of the wool. Thus, when the former are to be used, they must be boiled in a much stronger ley; when it is perceived that the ley is perfectly saturated with wool, and that it no longer changes it into soap, the operation is finished. After cooling, a soft and gelatinous soap is found at the bottom of the kettle, well adapted to various uses.

Observations.

1st. The stronger and hotter the ley is, the more powerfully it acts upon the wool, and the quantity of soapy matter obtained from it will be increased; on the contrary, a weak ley will disengage only a part of the oily matters of the wool, and produce a less perfect soap.

2d. To obtain the same kind of soapy substance, shreds of cloth, and other woollen stuffs, may be used; also, hair of all kinds; but in the use of this latter, a much stronger ley is necessary.

3d. When clean and pure substances are used, the soap produced from them is finer, and of better quality. It is therefore necessary to clean the pieces of wool intended for this use; they are to that end washed in river water, to free them from all impurities they may have contracted in the manufacturing.

4th. If to the mixture in the kettle, common salt is added, as is practised in the soap factories, the soap will be thicker and firmer.

5th. In case of want of care and attention, dirty or dyed wools are used, the soap will have a dirty tinge, and will give the cloths a grayish colour. This is of small consequence in cloths of deep colours, but for white cloths, it is requisite that the soap be drawn from white wools.

6th. Stuffs of deep coloured wools, when a soap not well managed is used, imbibe a disagreeable odour, which is dissipated when the stuffs are washed, and dried in the air.

7th. Soap prepared in this manner, may be used with the same advantage in the manufacture of muslins, cotton cloths, and other cotton fabrics; it may be used in place of common soap, in preparing stuffs before dying. The gray tint they then take is not injurious, but becomes of advantage to them in certain colours, because stuffs of cotton then become more susceptible of receiving the colour that it is wished to give them.

8th. If fat substances are added, or waste oil, or grease, the soap is more oily, firmer, and dissolves more readily. We know of a large factory, where no other soap is used.

[*Ibid.*

Suabian Method of Bleaching Spun Cotton and Hosiery.

We have just received from a Strasbourg correspondent, the description of a peculiar method of bleaching cotton yarn and hosiery,

used in Suabia. The operation is very quick, being completed in two days; there is no necessity of a place of great extent—a wash house is large enough; and in this respect, as well as the advantage of being practicable at all seasons, this process becomes interesting to small manufacturers, who cannot go to the expense of a regular bleaching establishment. Furthermore, the manipulations are few, and the workmen can, in a very short time, acquire the routine requisite to bleach with certainty.

A caustic alkaline ley is prepared in the following manner: two measures of quick-lime are put in a pile in one corner of the workshop, taking care that the walls against which the lime is placed are neither planked nor boarded. The lime is then covered gradually with ten measures of good ashes, which is spread equally over it, passing them through a sieve; this heap is sprinkled with water between every layer of ashes, and the cracks produced by the heat and motion in the mass, stopped with wet ashes. As soon as the lime is slacked, and this doughy mass entirely cooled, it is fit to form the ley.

The ley wash is formed by mixing this paste with cold water, then decanting the floating liquor, and lixiviating until no more alkali can be obtained; this liquor, which becomes of a fawn yellow colour, ought to be of a specific gravity of about ten to fifteen degrees of the areometer of Baumé, (1.07 to 1.11.)

For this operation, as well as for all bleaching, a soft water must be chosen, hard water producing frequent failures.

Skeins of cotton are taken, and being carefully untwisted, are tied in hanks, or bundles, to be immersed in the cold caustic alkaline wash; they are left in it during six hours, changing them from time to time.

The ley drained off is put aside, to be employed in a second washing, or for other uses.

The skeins are rinsed in river water, when taken out of the ley. After the rinsing, they are boiled in a bath of the same ley in which soap has been dissolved, in the proportion of six pounds to every seventy pounds of cotton, and ley in proportion, in order to clean them; this bath is kept boiling during twelve hours, in a copper kettle, which must be carefully cleaned after every operation. During the boiling, the cotton must be stirred about, to prevent that which is in contact with the bottom of the kettle, from burning, and to distribute the boiling equally through all the skeins. After coming out of the kettle, the cotton is again washed in river water.

The fifth manipulation is boiling in water without ley; the same proportion of soap is always used, viz: six pounds of soap, for seventy pounds of cotton, or hosiery; after cleansing the kettle well, river water is poured in, and the hanks or bundles are stirred about as before, and for the same length of time. Finally, the cotton is washed for the last time in river water, and then dried in the open air, upon the grass. In cold weather, the use of the grass drying may be dispensed with, and the cotton, &c. dried in a stove. It has been observed that the quicker it dries, the whiter it becomes. It is pre-

sumed, in all these manipulations, that the person who stirs the skeins of cotton, will be careful, and skilful enough, to avoid entangling the threads of the skeins. [*Ibid.*

¶ *Report on the Progress and Present State of our Knowledge of Hydraulics as a Branch of Engineering.* By GEORGE RENNIE, *Esq.*, *F. R. S.*, *&c.* &c.

PART I.

The paper now communicated to the British Association for the Advancement of Science, comprises a report on the progress and present state of our knowledge of Hydraulics as a branch of Engineering, with reference to the principles already established on that subject.

Technically speaking, the term hydraulics signifies that branch of the science of hydrodynamics, which treats of the motion of fluids issuing from orifices and tubes in reservoirs, or moving in pipes, canals, or rivers, oscillating in waves, or opposing a resistance to the progress of solid bodies at rest.

We can readily imagine that if a hole of given dimensions be pierced in the sides or bottom of a vessel kept constantly full, the expenditure ought to be measured by the amplitude of the opening, and the height of the liquid column.

If we isolate the column above the orifice by a tube, it appears evident that the fluid will fall freely, and follow the laws of gravity. But experiment proves that this is not exactly the case, on account of the resistances and forces which act in a contrary direction, and destroy part of, or the whole, effect. The development of these forces is so extremely complicated, that it becomes necessary to adopt some auxiliary hypothesis, or abbreviation, in order to obtain approximate results. Hence, the science of hydrodynamics is entirely indebted to experiment. The fundamental problem of it is to determine the efflux of a vein of water, or any other fluid, issuing from an aperture made in the sides or bottom of a vessel kept constantly full, or allowed to empty itself. Torricelli had demonstrated that, abstracting the resistances, the velocities of fluids issuing from very small orifices, followed the subduplicate ratio of the pressures. This law had been, in a measure, confused by subsequent writers, in consequence of the discrepancies which appeared to exist between the theory and experiment, until Varignon remarked that when water escaped from a small opening made in the bottom of a cylindrical vessel, there appeared to be very little, or scarcely any, sensible motion in the particles of the water; from which he concluded that the law of acceleration existed, and that the particles which escaped at every instant of time, received their motion simply from the pressure produced by the weight of the fluid column above the orifice, and that the weight of this column of fluid ought to represent the pressure on the particles which continually escape from the orifice; and that the quantity of motion or expenditure is in the ratio of the breadth of the orifice,

multiplied by the square of the velocity, or, in other words, that the height of the water in the vessel is proportional to the square of the velocity with which it escapes; which is precisely the theorem of Torricelli. This mode of reasoning is in some degree vague, because it supposes that the small mass which escapes from the vessel at each instant of time, acquires its velocity from the pressure of the column immediately above the orifice. But supposing, as is natural, that the weight of the column acts on the particle during the time it takes to issue from the vessel, it is clear that this particle will receive an accelerated motion, whose quantity in a given time will be proportional to the pressure multiplied by the time; hence the product of the weight of the column by the time of its issuing from the orifice, will be equal to the product of the mass of this particle by the velocity it will have acquired; and as the mass is the product of the opening of the orifice, by the small space which the particle describes in issuing from the orifice, it follows that the height of the column will be as the square of the velocity acquired. This theory is the more correct, the more the fluid approaches to a perfect state of repose, and the more the dimensions of the vessel exceed the dimensions of the orifice. By a contrary mode of reasoning, this theory became insufficient to determine the motions of fluids through pipes of small diameters. It is necessary, therefore, to consider all the motions of the particles of fluids, and examine how they are changed and altered by the figure of the conduit. But experiment teaches us that when a pipe has a different direction from the vertical one, the different horizontal sections of the fluid preserve their parallelism, the sections following taking the place of the preceding ones, and so on; from which it follows (on account of the incompressibility of the fluid) that the velocity of each horizontal section or plate, taken vertically, ought to be in the inverse ratio of the diameter of the section. It suffices, therefore, to determine the motion of a single section, and the problem then becomes analogous to the vibration of a compound pendulum, by which, according to the theory of James Bernouilli, the motions acquired and lost at each instant of time form an equilibrium, as may be supposed to take place with the different sections of a fluid in a pipe, each section being animated with velocities acquired and lost at every instant of time.

The theory of Bernouilli had not been proposed by him until long after the discovery of the indirect principle of *vis viva* by Huygens. The same was the case with the problem of the motions of fluids issuing from vessels, and it is surprising that no advantage had been taken of it earlier. Michelotti, in his experimental researches *de Separatione Fluidorum in Corpore Animali*, in rejecting the theory of the Newtonian cataract, (which had been advanced in Newton's *Mathematical Principles*, in the year 1687, but afterwards corrected in the year 1714,) supposes the water to escape from an orifice in the bottom of a vessel kept constantly full, with a velocity produced by the height of the superior surface; and that if, immediately above the lowest plate of water escaping from the orifice, the column of water be frozen, the weight of the column will have no effect on the velocity

of the water issuing from the orifice; and that, if this solid column be at once changed to its liquid state, the effect will remain the same. The Marquis Poleni, in his work *De Castellis per quæ derivantur Fluviorum Aquæ*, published at Padua, in the year 1718, shows, from many experiments, that if A be the orifice, and H the height of the column above it, the quantity of water which issues in a given time is represented by $2 \text{ A H} \times \frac{0.571}{1.000}$, whereas if it spouted out from the orifice with a velocity acquired by falling from the height H, it ought to be exactly 2 A H, so that experiment only gives a little more than half the quantity promised by the theory; hence, if we were to calculate from these experiments, the velocity that the water ought to have to furnish the necessary quantity, we should find that it would hardly make it reascend $\frac{1}{3}$rd of its height. These experiments would have been quite contrary to expectation, had not Sir Isaac Newton observed that water issuing from an orifice $\frac{5}{8}$ths of an inch in diameter, was contracted $\frac{21}{25}$th of the diameter of the orifice, so that the cylinder of water which actually issued was less than it ought to have been, according to the theory, in the ratio of 441 to 625; and augmenting it in this proportion, the opening should have been $2 \text{ A H} \frac{0.850}{1.000}$, or $\frac{4}{5}$ths of the quantity which ought to have issued, on the supposition that the velocity was in the ratio of the square root of the height, from which it was inferred that the theory was correct, but that the discrepancy was owing to certain resistances, which experiment could alone determine. The accuracy of the general conclusion was affected by several assumptions—namely, the perfect fluidity and sensibility of the mass, which was neither affected by friction nor cohesion, and an infinitely small thickness in the edge of the aperture.

Daniel Bernouilli, in his great work, *Hydrodynamica, seu de Viribus et Motibus Fluidorum Commentaria*, published at Strasburgh, in the year 1738, in considering the efflux of water from an orifice in the bottom of a vessel, conceives the fluid to be divided into an infinite number of horizontal strata, on the following suppositions—namely, that the upper surface of the fluid always preserves its horizontality; that the fluid forms a continuous mass; that the velocities vary by insensible gradations, like those of heavy bodies; and that every point of the same stratum descends vertically with the same velocity, which is inversely proportional to the area of the base of the stratum; that all sections thus retaining their parallelism are contiguous, and change their velocities imperceptibly; and that there is always an equality between the vertical descent and ascent, or *vis viva;* hence he arrives, by a very simple and elegant process, to the equations of the problem, and applies its general formulæ to several cases of practical utility. When the figure of the vessel is not subject to the law of continuity, or when sudden and finite changes take place in the velocities of the sections, there is a loss of *vis viva*, and the equations require to be modified. John Bernouilli and Maclaurin arrived at the same conclusions by different steps, somewhat analogous to the cataract of Newton. The investigations of D'Alembert had been

directed principally to the dynamics of solid bodies, until it occurred to him to apply them to fluids; but in following the steps of Bernouilli, he discovered a formula applicable to the motions of fluid, and reducible to the ordinary laws of hydrostatics. The application of his theory to elastic and non-elastic bodies, and the determination of the motions of fluids in flexible pipes, together with his investigations relative to the resistance of pipes, place him high in the ranks of those who have contributed to the perfection of the science.

The celebrated Euler, to whom every branch of science owes such deep obligations, seems to have paid particular attention to the subject of hydrodynamics; and in attempting to reduce the whole of it to uniform and general formulæ, he exhibited a beautiful example of the application of analytical investigation to the solution of a great variety of problems, for which he was so famous. The *Memoirs of the Academy of Berlin*, from the year 1768 to 1771, contain numerous papers relative to fluids flowing from orifices in vessels, and through pipes of constant or variable diameters. "But it is greatly to be regretted," says M. Prony, "that Euler had not treated of friction and cohesion, as his theory of the linear motion of air would have applied to the motions of fluids through pipes and conduits, had he not always reasoned on the hypotheses of mathematical fluidity, independently of the resistances which modify it."

In the year 1765, a very complete work was published at Milan, by Paul Lecchi, a celebrated Milanese engineer, entitled *Idrostatica esaminata ne' suoi Principi e Stabilite nelle suoi Regole della Mensura della Acque correnti*, containing a complete examination of all the different theories which had been proposed to explain the phenomena of effluent water, and the doctrine of the resistance of fluids. The author treats of the velocity and quantity of water, whether absolutely or relatively, which issues from orifices in vessels and reservoirs, according to their different altitudes, and inquires how far the law applies to masses of water flowing in canals and rivers, the velocities and quantities of which he gives the methods of measuring. The *extensive and successful practice* of Lecchi as an engineer, added much to the reputation of his work.*

In the year 1764, Professor Michelotti, of Turin, undertook, at the expense of the king of Sardinia, a very extensive series of experiments on running water, issuing through orifices and additional tubes, placed at different heights, in a tower of the finest masonry, twenty feet in height, and three feet square inside. The water was supplied by a channel two feet in width, and under pressures of from five to twenty-two feet. The effluent waters were conveyed into a reservoir of ample area, by canals of brick-work lined with stucco, and having various forms and declivities; and the experiments, particularly on the efflux of water through differently shaped orifices, and additional tubes of different lengths, were most numerous and accurate; and Michelotti was the first who gave representations of the changes which take place in the figure of the fluid vein, after it

* See also *Memorie Idrostatico-storiche*, 1773.

has issued from the orifice. His experiments on the velocities of rivers, by means of the bent tube of Pitot, and by an instrument resembling a water-wheel, called the *stadera idraulica*, are numerous and interesting; but, unfortunately, their reduction is complicated with such various circumstances, that it is difficult to derive from them any satisfactory conclusions. But Michelotti is justly entitled to the merit of having made the greatest revolution in the science by experimental investigation.* The example of Michelotti gave a fresh stimulus to the exertions of the French philosophers, to whom, after the Italians, the science owes the greatest obligations. Accordingly, the Abbé Bossut, a most zealous and enlightened cultivator of hydrodynamics, undertook, at the expense of the French government, a most extensive and accurate series of experiments, which he published in the year 1771, and a more enlarged edition, in two volumes, in the year 1786, entitled *Traité Théorique et Expérimental d'Hydronamique*. The first volume treats of the general principles of hydrostatics and hydraulics, including the pressure and equilibrium of non-elastic and elastic fluids, against inflexible and flexible vessels; the thickness of pipes to resist the pressure of stagnant fluids; the rise of water in barometers and pumps, and the pressure and equilibrium of floating bodies; the general principles of the motions of fluids through orifices of different shapes, and their friction and resistance against the orifices; the oscillations of water in syphons; the percussion and resistance of fluids against solids; and machines moved by the action and reaction of water. The second volume gives a great variety of experiments on the motions of water through orifices and pipes and fountains; their resistances in rectangular or curvilinear channels, and against solids moving through them; and lastly, of the fire or steam engine. In the course of these experiments, he found that when the water flowed through an orifice in a thin plate, the contraction of the fluid vein diminished the discharge in the ratio of 16 to 10; and when the fluid was discharged through an additional tube, two or three inches in length, the theoretical discharge was diminished only in the ratio of 16 to 13. In examining the effects of friction, Bossut found that small orifices discharged less water in proportion than large ones, on account of friction, and that, as the height of the reservoir augmented, the fluid vein contracted likewise; and by combining these two circumstances together, he has furnished the means of measuring with precision the quantity of water discharged either from simple orifices or additional tubes, whether the vessels be constantly full, or be allowed to empty themselves. He endeavoured to point out the law by which the diminution of expenditure takes place, according to the increase in the length of the pipe, or the number of its bends; he examined the effect of friction in diminishing the velocity of a stream in rectangular and curvilinear channels; and showed that in an open canal, with the same height of reservoir, the same quantity of water is always discharged, whatever be the declivity and length; that the velocities of

* *Sperimenti Idraulici*, 1767 and 1771.

the waters in the canal are not as the square roots of the declivities, and that in equal declivities and depth of the canal, the velocities are not exactly as the quantities of water discharged; and he considers the variations which take place in the velocity and level of the waters when two rivers unite, and the manner in which they establish their beds.

His experiments, in conjunction with D'Alembert and Condorcet, on the resistance of fluids, in the year 1777, and his subsequent application of them to all kinds of surfaces, including the shock and resistance of water-wheels, have justly entitled him to the gratitude of posterity. The Abbé Bossut had opened a new career of experiments; but the most difficult and important problem remaining to be solved, related to rivers. It was easy to perform experiments with water running through pipes and conduits on a small scale, under given and determined circumstances; but when the mass of fluid rolled in channels of unequal capacities, and which were composed of every kind of material, from the rocks amongst which it accumulated, to the gravel and sand through which it forced a passage—at first a rapid and impetuous torrent, but latterly holding a calm and majestic course—sometimes forming sand-banks and islands, at other times destroying them, at all times capricious, and subject to variation in its force and direction by the slightest obstacles—it appeared impossible to submit them to any general law.

Unappalled, however, by these difficulties, the Chevalier Dubuat, after perusing attentively M. Bossut's work, undertook to solve them by means of a theorem which appeared to him to be the key of the whole science of hydraulics. He considered that if water was in a perfect state of fluidity, and ran in a bed from which it experienced no resistance whatever, its motion would be constantly accelerated, like the motion of a heavy body descending an inclined plane; but as the velocity of a river is not accelerated *ad infinitum*, but arrives at a state of uniformity, it follows that there exists some obstacle which destroys the accelerating force, and prevents it from impressing upon the water a new degree of velocity. This obstacle must therefore be owing either to the viscidity of the water, or to the resistance it experiences against the bed of the river; from which Dubuat derives the following principle:—That when water runs uniformly in any channel, the accelerating force which obliges it to run is equal to the sum of all the resistances which it experiences, whether arising from the viscidity of the water, or the friction of its bed. Encouraged by this discovery, and by the application of its principles to the solution of a great many cases in practice, Dubuat was convinced that the motion of water in a conduit pipe was analogous to the uniform motion of a river, since in both cases gravity was the cause of motion, and the resistance of the channel or perimeter of the pipes, the modifiers. He then availed himself of the experiments of Bossut, on conduit pipes and artificial channels, to explain his theory; the results of which investigations were published in the year 1779. M. Dubuat was, however, sensible that a theory of so much novelty, and at variance with the then received theory, required to

be supported by experiments more numerous and direct than those formerly undertaken, as he was constrained to suppose that the friction of the water did not depend upon the pressure, but on the surface and square of the velocity. Accordingly, he devoted three years to making fresh experiments, and, with ample funds and assistance provided by the French government, was enabled to publish his great work, entitled "Principes d'Hydraulique vérifiés par un grand nombre d'Expériences, faites par Ordre du Gouvernement," 2 vols. 1786, (a third volume, entitled "Principes d'Hydraulique et Hydronamique," appeared in 1816;)—in the first instance, by repeating and enlarging the scale of Bossut's experiments on pipes (with water running in them) of different inclinations or angles, of from 90° to $\frac{1}{40000}$th part of a right angle, and in channels of from $1\frac{1}{2}$ line in diameter to 7 and 8 square toises of surface, and subsequently to water running in open channels, in which he experienced great difficulties in rendering the motion uniform; but he was amply recompensed by the results he obtained on the diminution of the velocity of the different parts of a uniform current, and of the relation of the velocities at the surface and bottom, by which the water works its own channel, and by the knowledge of the resistances which different kinds of beds produce, such as clay, sand, and gravel; and varying the experiments on the effect of sluices, and the piers of bridges, &c., he was enabled to obtain a formula applicable to most cases in practice.*

Thus, let V = mean velocity per second, in inches.

d = hydraulic mean depth, or quotient which arises from dividing the area or section of the canal, in square inches, by the perimeter of the part in contact with the water, in linear inches.

s = the slope or declivity of the pipe, or the surface of the water.

g = 16·087, the velocity in inches which a body acquires in falling one second of time.

n = an abstract number, which was found by experiment to be equal to 243·7.

$$\text{then } v = \frac{\sqrt{n\,g\,(\sqrt{d} - 0.1)}}{\sqrt{s} - \log.\sqrt{s} + 1.6} - 0.3\,(\sqrt{d} - 0.1).$$

Such are some of the objects of M. Dubuat's work. But his hypotheses are, unfortunately, founded upon assumptions which render the applications of his theory of little use. It is evident that the supposition of a constant and uniform velocity in rivers cannot hold: nevertheless, he has rendered great services to the science, by the solution of many important questions relating to it; and although he has left, on some points, a vast field open to research, he is justly entitled to the merit of originality and accuracy.

Contemporary with Dubuat was M. Chezy, one of the most skilful engineers of his time; he was director of the Ecole des Ponts et Chaussées, and reported, conjointly with M. Perronet, on the Canal

* Edinburgh Encyclopedia, art. Hydrodynamics, by Brewster.

Yvette. He endeavoured to assign, by experiment, the relation existing between the inclination, length, transversal section, and velocity of a canal. In the course of this investigation, he obtained a very simple expression of the velocity, involving three different variable quantities, and capable, by means of a single experiment, of being applied to all currents whatever. He assimilates the resistance of the sides and bottom of the canal to known resistances, which follow the law of the square of the velocity, and he obtains the following simple formula:

$v = \frac{\sqrt{g\,d}}{z\,s}$, where g is = 16.087 feet, the velocity acquired by a heavy body, after falling one second.

d = hydraulic mean depth, equal to the area of the section divided by the perimeter of the part of the canal in contact with the water.

s = the slope or declivity of the pipe.

z = an abstract number, to be determined by experiment.

In the year 1784, M. Lespinasse published, in the "Memoirs of the Academy of Sciences at Toulouse," two papers, containing some interesting observations on the expenditure of water through large orifices, and on the junction and separation of rivers. The author had performed the experiments contained in his last paper, on the rivers Fresquel and Aude, and on that part of the canal of Languedoc below the Fresquel lock, towards its junction with that river.

As we before stated, M. Dubuat had, with much sagacity classified his observations on the different kinds of resistance experienced in the motion of fluids, and which might have led him to express the sum of the resistances by a rational function of the velocity composed of two or three terms only. Yet the merit of this determination was reserved to M. Coulomb, who, in a beautiful paper, entitled "Expériences destinées à déterminer la Cohérence des Fluides et les Lois de leurs Résistances dans les Mouvemens très lents," proves, by reasoning and facts,

1st, That in extremely slow motions, the part of the resistance is proportional to the square of the velocity.

2dly, That the resistance is not sensibly increased by increasing the height of the fluid above the resisting body.

3dly, That the resistance arises solely from the mutual cohesion of the fluid particles, and not from their adhesion to the body upon which they act.

4thly, That the resistance in clarified oil, at the temperature of 69° Fahrenheit, is to that of water as 17·5 : 1; a proportion which expresses the ratio of the mutual cohesion of the particles of oil, to the mutual cohesion of the particles of water.

M. Coulomb concludes his experiments by ascertaining the resistance experienced by cylinders that move very slowly, and perpendicularly to their axes, &c.

This eminent philosopher, who had applied the doctrine of torsion with such distinguished success, in investigating the phenomena of

electricity and magnetism, entertained the idea of examining, in a similar manner, the resistance of fluids, contrary to the doctrines of resistance previously laid down. M. Coulomb proved that, in the resistance of fluids against solids, there was no constant quantity of sufficient magnitude to be detected; and that the pressure sustained by a moving body is represented by two terms, one which varies as the simple velocity, and the other with its square.

The apparatus with which these results were obtained, consisted of disks of various sizes, which were fixed to the lower extremity of a brass wire, and were made to oscillate under a fluid, by the force of torsion of the wire. By observing the successive diminution of the oscillations, the law of resistance was easily found. The oscillations which were best suited to these experiments, continued for twenty or thirty seconds, and the amplitude of the oscillation (that gave the most regular results) was between 480, the entire division of the disk, and 8 or 10 divisions from zero.

[TO BE CONTINUED.]

Accounts of the means employed for the recovery of Treasure, Stores, and other Property, from the Wreck of the Thetis. By Commander DE ROOS, *R. N., and Commander* DICKINSON, *R. N.*

The following are abstracts, from the *Proceedings of the Royal Society*, of two papers on the recovery of treasure and stores from the wreck of the Thetis, which were read before that learned body, on the 20th and 27th of February, and 20th of March last.

Abstract of "An Account of some Operations executed at Cape Frio, by the Officers and Crew of His Majesty's Ship Algerine, for the purpose of raising a part of the Stores, &c. lost in His Majesty's Ship Thetis. By the Hon. Commander F. T. De Roos, R. N., F. R. S."

Captain De Roos, who had the command of his majesty's ship Algerine, was instructed to take charge of the enterprise commenced by the officers and crew of his majesty's ship Lightning, having for its object the recovery of the treasure and stores from the wreck of the Thetis, which, in the month of December, 1830, had sunk in a cove to the south-east of Cape Frio. He reached this spot on the 6th of March, 1832, having with him eleven officers and eighty-five men. A certain number of men were appointed to remain on board the ship, which was moored in a harbour about two miles off, a party of artificers and others were employed at the huts which they inhabited near the Cape; and the rest, nearly thirty-five in number, were stationed at the wreck.

The Captain gives a description of Cape Frio, and of the island of which it forms the south-eastern extremity, and which is an immense promontory of insulated granite jutting into the Atlantic Ocean, sixty miles east of Rio de Janiero. The cove, in the middle of which the wreck of the Thetis lay, is a square indenture in the cliffs, six hundred feet deep by as many wide. It is surrounded by nearly perpen-

dicular masses of granite, from one hundred to two hundred feet high, and is exposed to the whole swell of the South Atlantic, which sets in with remarkable force in that direction. The weather is singularly variable; and transitions frequently take place in the course of a few hours, from perfect stillness to the most tremendous swell. The Captain states that he has witnessed few scenes in nature more sublime than that presented by the Thetis Cove during a gale of wind from the south-west.

The Captain enters into a minute description of the mechanical apparatus employed for obtaining the necessary purchases for the various operations which were required, and gives a circumstantial history of his proceedings. Frequent interruptions were experienced from the state of the weather, and the almost incessant agitation of the water, which was often so powerful as to render the diving bell unmanageable, and to expose the divers to serious danger. The diving bell consisted of a one-ton ship's water tank, with eight inches of iron riveted to the bottom, in order to give it more depth, and having attached to it eighteen pigs of ballast, the weight of which (17 cwt.) was found to be sufficient to sink it.

As soon as the necessary arrangements had been completed, the Captain states that he made a minute survey of the bottom, by means of the diving bell, and ascertained the exact position and shape of all the large rocks which covered the spot where the treasures and stores of the Thetis had been scattered. The shape of the area where the precious metals in particular had been deposited, was an ellipse, of which the two principal axes measured forty-eight and thirty-one feet; and large boulders of granite had been subsequently rolled over these treasures, and required be to removed before the latter could be recovered. The superincumbent pressure of the sea, aided by the huge materials of the wreck of the frigate, which, under the influence of the swell, acting like a paviour's hammer, with enormous momentum, had jammed together the rocks, and produced a strong cohesion between the fragments of wood and the gold, silver, and iron.

The first object was to clear away every portion of the wreck; and after this had been accomplished, to loosen and remove all the large rocks in succession, beginning with the smallest, and ending with the largest and most unwieldy. Some of these, which they succeeded in rolling from their situations into deeper water, weighed about thirty or forty tons; and the largest, which it required the greatest efforts to move from its place, was computed to weigh sixty-three tons. This last effort served to show, that no part, either of the wreck or the stores, which was of any value, remained behind; and after fifteen-sixteenths of the property had been recovered, the enterprise, which had so perfectly succeeded, terminated on the 24th of July, and the Algerine returned to Rio de Janeiro on the 1st of August.

The Captain subjoins an account of the current off Cape Frio, and a description of the climate, which seems to have been favourable, for his party suffered but little from sickness, and the expedition was unattended with the loss of a single life. On one occasion the party were visited by a whale, which approached very near the div-

ing bell, but fortunately changed its course without doing any mischief.

The narrative commences with the statement of the consternation produced at Rio de Janeiro on the receipt of the intelligence of the loss of the Thetis, with a freight of about 810,000 dollars, on the south-west side of the Island of Cape Frio, and of the determination of the author, on finding that no one seemed disposed to take any step towards the recovery of the property thus lost, to make the attempt himself, if he could obtain from the Commander in Chief at that station, Rear Admiral Thomas Baker, C. B., orders to that effect. He accordingly exerted himself to obtain every possible information relative to the nature of the coast, depth of water, and other circumstances, which might enable him to judge of the practicability of the undertaking, and of the means necessary for its successful accomplishment; and became convinced that the difficulties and obstacles to be encountered, although numerous and formidable, might be overcome by the employment of the means which suggested themselves to him as practicable on this occasion, if sufficient assistance were afforded him in putting them into execution. He accordingly had models of the proposed machinery made, and submitted them, together with his plan, to the Commander in Chief, by whom they were approved. He experienced great difficulty in procuring a suitable diving bell, for it was impossible to obtain any instrument of the kind at Rio de Janiero, or even any facilities for the construction of one by casting. It at length occurred to him, that a ship's iron water tank might be converted to this use; and being supplied with one from the Warspite, he was enabled to render it available for that purpose. The next difficulty was to procure an air-pump, which, after much delay, owing to the tardiness of the native workmen in that country, was at length constructed. The want of air-hoses, however, was a still more formidable obstacle to the success of the plan; but the ingenious contrivances of the author for rendering the common pump hoses air tight, supplied this deficiency; and on a trial which he made with the whole apparatus on the 22d of January, 1831, it was found to answer completely. The next day he received his orders from the Commander in Chief, and, sailing on the following day, arrived at the harbour of Cape Frio on the 30th, and immediately proceeded to inspect the coast, and ascertain the situation of the wreck, not a vestige of which was visible. An account is then given of the local circumstances of the Thetis Cove, or inlet, surrounded by almost perpendicular cliffs, from 168 to 194 feet in height, with a depth of water varying from $3\frac{1}{2}$ to 24 fathoms, and the bottom being strewed with huge perpendicular rocks, occasioning these inequalities. These surveys showed that the execution of the plan originally conceived by the author was opposed by so many unforeseen difficulties, that he was obliged to relinquish some part of it, and resort to fresh expedients for surmounting them. The idea of constructing a derrick then occurred to him, but the materials were wanting, for no trees existed in the island, except those in the forests in the interior, which were inaccessible from their distance and the heights on which they grew,

and of which the wood was, from its quality, unsuitable to the purpose. His only resource, therefore, was to make it of the fragments of spars saved from the wreck. With great exertions, a circumstantial account of which is given in the paper, the work was at length accomplished; and the result fully equalled the anticipations which had been formed of its utility in affording a stable point of support for the operations with the diving bell. Previously to the erection of a derrick, however, much had been done by working the diving bell from a boat, and a considerable quantity of stores and treasure raised. At one time the anxiety of the author to forward the undertaking, and avail himself of favourable weather, induced him to try the experiment of working by torch-light, which succeeded to a certain extent; but after a few trials the danger was found to be excessive, and the fatigue to the divers so great as to oblige him to desist.

After the derrick had been for some time in operation, a tremendous sea arose, the shock of which, for want of sufficient materials to support it, effected its destruction; and a substitute was then resorted to by the setting up of a suspension cable diagonally from the cliffs, which, after great difficulties, was at length effected.

A great portion of the narrative is occupied with details of the various proceedings, and of the serious impediments which were successively overcome by the zeal, perseverance, and extraordinary exertions of the officers and crew, under the orders of Captain Dickinson, subjected as they were, for so long a period, to the greatest privations and hardships, arising from the labourious nature of the work, the unhealthiness of the climate, the attacks of the chigger, (producing distressing ulcers in the feet,) the annoyance from drifting sand, which penetrated into every place, the exposure to constant wet in huts which could not be made to exclude either wind or rain, and the perils arising from the boisterous gales and tremendous swell of the sea, which the whole ship's company, but more particularly the men in the diving bell, had to encounter; forming a combination of difficulties which the author is convinced could have been surmounted by none but British seamen.

After having succeeded so far in the undertaking, and made, at various times, shipments for England of treasure amounting to about three-fourths of the whole which had been on board the Thetis when she sunk, orders were received by the author, on the 6th of March to resign the charge of the enterprise to the Honourable Captain De Roos, of his majesty's brig Algerine; on the receipt of which he immediately ordered a survey to be taken of the stores, and on the 9th descended in the bell, surveyed the bottom of the cove, ascertained the position of the remaining stores, and a considerable quantity of treasure; and after having communicated the whole of the results to Captain De Roos, instructed him, his officers and ship's company, in the way of working the bell, as well as in the different modes of removing rocks, recovering stores and treasure, and the use of the whole of the machinery, and furnished him with every necessary information for his guidance; he lent twenty of his men to the Algerine for their

assistance, resigned the charge to his direction on the 10th, and sailed for Rio de Janeiro on the 13th.

On the Effects of Size in Mechanical Construction.

The influence of size upon the strength and forcible motion of machines and mechanical structures generally, is strikingly exhibited in the difference between the results obtained from models of machines, and the results of the same machines executed on a large and powerful scale.

When a new theory or fundamental proposition in science is put forth, or when a new machine is invented, we frequently find conclusions drawn from experiments made with small models, which are not supported afterwards by the results of practice on a large scale; and hence practised engineers put very little faith in the results obtained by experiments with models.

There are several reasons for this frequent discrepancy between experimental and practical results, and the same reasons do not operate in all cases; it is useful therefore to distinguish between them.

One reason why the effect of a model of a machine is very frequently no index of the effect of the machine itself, is, that the *intensity of operation* of the properties of matter is not always proportionate to the mere *quantity of matter;* that is, there is, in respect to all matter, a certain point at which its properties *begin to act*, and before which they are only *latent.* And in models, very frequently, that point is not reached at all.

For example, let us take *vibration.*

A *heavy iron chain* suspended between two points, may, by setting it swinging, be broken by its *own vibration.* But if a very *slender wire* were suspended between two points proportionably distant from each other, it would be impossible to cause it to break by *its own vibration.*

The reason of the difference of results is, that the cause of fracture is the *momentum acquired by the body in motion;* which momentum, being governed by the *weight* and *square of the velocity*, may easily be caused, in the case of a heavy chain, to *exceed the ultimate strength* of the chain.

But in the case of a fine wire, the *weight* being next to nothing, the momentum requisite to cause fracture can only be produced by combining the weight with a *very high velocity;* a velocity in fact so high, that it would be, from the nature of the experiment, almost impracticable to obtain it.

Hence the point at which *effective vibration* begins, is beyond the limits of a trial with a wire, and within them in a trial with a chain.

Again, in respect to *friction:* in all bodies that we know, the particles require a certain time to yield to *forcible disturbance* of their positions. This is the reason why a boat drawn through the water at a very high velocity, rises towards the surface, and has its displacement diminished. The number of particles of water displaced re-

quires a greater time to yield to the force applied to each successive layer of particles, than is allowed to them by the velocity of the boat. Hence *the boat* is compelled to yield, and run above those particles which it cannot disturb.

The same is probably the reason of the *ascertained fact*, that "the draught of a stage coach on a common turnpike road, increases in *a less ratio than the velocity;*"* and of the most probable fact, that the same law obtains in respect to rail-road carriages. That is, in both cases, the materials of the road are of the nature of fluids, in so far, that bodies laid upon them, which have sufficient weight to cause *any sensible friction*, do so by *sinking into the substance of the material*, perceptibly or imperceptibly. And the carriage wheels, when put in motion, must either crush all those particles which lie in front of them, or displace the particles, or else be displaced by them.

Now because the particles of the road, whether iron or stone, require (like the particles of other bodies) a *particular time* (according to their particular nature) to yield to force, and be disturbed without being crushed, it follows, that unless the superincumbent weight be sufficient to *crush* the particles, it will, if the increments of its motion be greater than the time required by the particles of the road to yield to its force, be lifted up above those particles which it can *neither crush nor displace*. By this rising partially out of the medium in which it moves, it becomes a body of less displacement, and meeting fewer particles, will have less friction, if its velocity be maintained.

Now all this theory depends upon observations which could not be made satisfactorily in experiments on a small scale; because the thing to be observed is the operation of properties of matter, which are *latent* up to a certain point; that is, the compressibility of a good turnpike-road, or of an iron rail-road, is latent, until a *certain amount of weight* be applied upon it, and that amount would be unattainable in a model. Hence experiments upon plans for impelling locomotive carriages, where the advantage or disadvantage depends upon the question of increase or diminution of friction, are inconclusive when conducted on a small scale, because they *never bring the resistance sought to be measured, into operation.*

In all experiments, therefore, before settling the size of the models, or indeed before determining whether models shall be used at all, it should be ascertained whether the forces that will be brought into play in them, will be of *sufficient absolute intensity* to act *at all* upon the *forces of resistance* they will encounter; because, if too small to do that, it is plain that they are quite useless, and are no index whatever to the real operation of the machines constructed after them. Another reason why the results of experiments with models are so often inconclusive is, that the operations being on a very small scale, and *all the quantities* proportionably small, their *differences* are necessarily too minute to be accurately estimated, and very small errors lead to very erroneous inferences. And further, in constructing models, we seldom observe that proportion between *the strengths and forces of the operative parts*, and the *strengths and forces of the resisting parts*,

* Vide Sir H. Parnell on Roads, p. 337. Mr. M'Neill's Paper.

which we must observe in a large structure; and the mind is usually inclined to make small things over strong, so that defects of principle escape under cover of a mass of matter.

Errors have clearly been traceable to these sources in some instances where works have been executed on a small scale, and have answered; and on a large scale, precisely on the same principle, and have failed.

In the early periods of constructing suspension bridges, many of small size were made with the platform supported by inclined wires, which stood very well. Afterwards, a large one was attempted on the same plan, and was broken down by a gale of wind. There is no reason to suppose that it failed from bad proportions or bad workmanship; but the reason of the difference of results was, that the principle of the construction is defective, because the chains, if drawn nearly tight, are too much weakened, and if left slack, forming all different curves, their vibrations (produced by a gale of wind) are unequal in amount, and hence each does not bear its fair share of strain.

This defect of principle would remain latent in a *small structure;* first, because there would most likely be a great superabundance of strength; secondly, because the whole mass of matter would be too light to injure itself by its own vibration. But when the same principle was carried into a larger structure, the force brought into operation by motion of the parts would be greatly increased; the strength of the parts would most likely not exceed so much the resistance to be overcome, and the defect of principle ceased, therefore, to be latent.

Again, in constructing *steam engines.* The bell crank engine, made of a small size, answered very well; it was attempted on a large scale, and failed. Now the defect of the bell-crank engine is, that it is out of balance; the piston being *urged* by its own weight, and that of the parts connected with it, in addition to the force of the steam, in *the down stroke,* and being *resisted* by the same weights in the *ascending stroke.* This defect of principle was latent while the machine was of small power; because the weight that acted in an injudicious manner was so small in proportion to the mass, and strength, and hardness, of the materials, as not to acquire sufficient momentum to affect sensibly the stability of the structure or the wear of the materials: but in a large machine, the hardness of the materials remained the same, and the mass of matter that had to endure the force transmitted through it, and was probably (on the principle that large structures are usually made weaker in proportion than small ones) much less in proportion to the amount of force transmitted than in the small engine. Hence the defect of principle became sensible.

Lastly, the extraordinary results said to be obtained lately in experiments upon an undulating rail-way, and the inferences drawn from them by many not firm in their mechanical faith, are a striking example of that cause of error which springs from overlooking some effects or circumstances, and the differences between quantities observed, on account of the minuteness of the quantities dealt with.

It is affirmed, and I believe with truth, that in those experiments a model of a locomotive carriage, impelled by a spring, performed a

given horizontal distance on an undulating rail-way, in less time than it performed the same horizontal distance on a horizontal rail-way,—all other circumstances, except that of horizontality and undulation, being *apparently* alike; and hence a total subversion of received principles was inferred. The error of the inferences arose from its not being at first observed, that in the case of the horizontal line, the model had *more disposition to forcible motion left in it after performing its journey*, than it had on the undulating line: nor did it require any extraordinary neglect to allow such a fact to pass unnoticed, as the difference was probably so minute as to be hardly perceptible, unless measured by some delicate instrument.

In conclusion, therefore, I would observe, that experiments with models, to be at all relied on, should be conducted with the most minute attention, to endeavour to place them under like circumstances, in all respects, to those that will take place in practice on a large scale; that they should never be resorted to when experiments on a large scale *can be made;* and that they should never be trusted, under any circumstances, as furnishing more than *data to judge of probable effects.* (*Lond. Journ.*

¶ *Iron Steamboat.*

A large iron steamer, 96 feet long, was lately launched at Selby, built by Mr. Fairburn, of Manchester, for Swiss owners, and is intended to ply on the Lake Zurich. She will be navigated as far up the Rhine as possible, and then taken to pieces, and carried overland to her destination. She draws less than twelve inches water, without cargo. This steamer was built at Manchester, taken to pieces and brought to Selby, put together and launched, and when taken out of the water, will again be taken to pieces, carried overland a distance of forty miles in a rugged country, and ultimately launched at Zurich; and, after all this, will be considerably cheaper and better than if built on the continent.—*Mech. Mag.*

¶ *Human Strength.*

From experiments made at Portsmouth dock-yard, in driving and pressing in iron and copper bolts, a man of medium strength, striking with a mallet, weighing 18 lbs., and the handle 14 inches long, would start a bolt about one-eighth of an inch every blow. It required a pressure of 107 tons to press the same bolt down the same quantity of space, but a small additional weight pressed it completely home. [*Ibid.*

¶ *Scotch India Muslins.*

We have recently been assured that a piece of muslin, manufactured at Paisley, was purchased in India by the son of the manufacturer, and sent home as a specimen of the superiority of the products of the Indian loom. [*Athenæum.*

CELESTIAL PHENOMENA, FOR FEBRUARY, 1835.

Calculated by S. C. Walker.

Day.	H'r.	Min.					
2	8	22	Im.	26 Ceti,	,6,7,	N44°	V92°
2	9	41	Em.			14°	64°
13	5	41	Im.	46 i Leonis,	,6,	118°	70°
13	6	21	Em.			214°	169°
16	12	30	Im.	66 Virginis,	,6,	38°	331°
16	13	15	Em.			286°	250°
20	16	39	Im.	33 Ophinchi,	,6,	126°	101°
20	17	20	Em.			194°	174°
28	6	14	N. App. ☽ and 249 Piscium, .7,			☽ N. 3',4	

Meteorological Observations for November, 1834.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches.	Inches.			Inches.	
⊗	1	39°	50°	30.20	30.65	E.	Moderate.		Cloudy—lightly cloudy—rain, hail
	2	30	40	.20	.70	NE.	do.	0.12	Snow—cloudy. [& snow in night
	3	26	44	.30	.30	NE.	do.		Clear day.
	4	37	53	.35	.15	SW.	do.		Clear—lightly cloudy.
	5	46	48	29.90	29.90	E. NW.	do.		Cloudy day.
	6	33	49	30.00	30.15	N.	Blustering		Cloudy—clear.
	7	34	57	29.80	29.85	NW. NW.	do.		Clear—cloudy—with a heavy gale
	8	44	52	.80	.90	W. NW.	do.		Clear day. [of wind
☾	9	32	49	30.20	30.20	NW. S.	Moderate		Clear day.
	10	33	52	.00	.00	SW.	Calm		Hazy.
	11	45	47	.00	29.85	NW.	Variable.		Cloudy—lightly cloudy.
	12	31	45	29.95	.85	WSW.	Moderate.		Clear—hazy.
	13	34	54	.85	.90	SE.	Calm.		Cloudy—rain.
	14	46	51	.90	.50	SE.	do.	0.07	Cloudy—rain in night.
	15	28	31	.91	.91	NW.	do.	0.13	Cloudy day.
	16	99	30	30.65	30.65	NE.	Moderate.		Cloudy day.
⊕	17	28	32	.85	.85	NE.	do.		Sleet and rain—cloudy.
	18	44	47	29.61	29.61	NW. W.	Blustering	1.45	Drizzle—rain.
	19	43	47	.60	.60	W.	Moderate.		Lightly cloudy.
	20	37	46	.65	.65	N.	do.		Cloudy—flying clouds.
	21	34	43	.65	.65	W. NW.	do.		Lightly cloudy—clear.
	22	32	51	.83	.83	SE. S.	do.	0.04	Cloudy—rain.
	23	36	43	.60	.60	W. NW.	Blustering		Clear—flying clouds.
☽	24	33	35	.75	.75	W.	do.		Flying cloud—cloudy.
	25	29	33	.65	.65	W.	do.		Cloudy—flying clouds.
	26	28	40	.90	.90	W.	Calm.		Cloudy—flying clouds.
	27	29	44	.95	.95	W.	Moderate.		Clear—cloudy.
	28	34	45	30.00	30.00	SW.	do.		Clear—flying clouds.
	29	36	50	29.80	29.60	SW.	do.		Clear day.
	30	36	46	.90	.90	W.	do.	0.40	Cloudy—rain.
⊗	Mean	34.57	45.10	29.95	29.91			2.21	Clear—lightly cloudy—sun cet'd.

Thermometer.		Barometer.
Maximum height during the month,	57. on 7th,	30.85 on 17th.
Minimum do.	20. on 16th.	29.50 on 14th.
Mean do.	39.83	29.92